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MAR 15 1957

PIPE LINE INDUSTRY

MARCH
1957

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SPECIAL CORROSION REPORT

Anode Net 'Covers' Station Piping

. . . p. 20

Chart Makes Ground Bed Design Easy

. . . p. 24

Tests Will Prove Good Pipe Coating

. . . p. 28

Get Top Performance From Rectifiers

. . . p. 39

AUTOMATION ADVANCES

Digital Telemetering Helps Control

. . . p. 45

SUPERVISOR'S GUIDE

Check-List for Effective Leadership

. . . p. 57

For a "Quick Look" at this issue, turn the page . .

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PIPE LINE INDUSTRY

CONTENTS and Quick Look

March, 1957 Vol. 6, No. 3

B 642307

To help you put first things first, scan these time-saving digests, checking ☑ those you want to read first.

THE FACTS ABOUT OIL PRICES

☐ Since crude oil and gasoline prices were increased early this year, the American public has been subjected to a deluge of misleading statements about the oil industry and its operations. In an effort to help set the record straight, PIPE LINE INDUSTRY is including as a supplement to this issue a collection of facts and figures that tell the true story. This information is not bound in the issue so that it can be read and passed along to your coworkers and friends outside the industry. Reprints are also available.

SPECIAL REPORT ON CORROSION

Properly Placed Anodes Protect Station Piping

☐ Provide complete protection for all buried station piping with this program of Tennessee Gas Transmission Company for installing distributed anode systems. Good design, cooperation of station personnel during installation and careful testing greatly reduce corrosion and possibility of leaks.

By R. G. Ransom ..... Page 20

Modern Ground Bed Design Saves Money

☐ Whether revising or engineering a new system, proper and adequate care will show a profit from savings in power costs and total investment. Here is a time-saving chart and nomograph to help you get accurate answers with ease.

By John E. Searcy, Jr. ..... Page 24

What Makes a Good Pipe Line Coating?

☐ You buy protection when you purchase a coating material. Laboratory tests plus field experience measure the performance of the coating. With these written specifications as a guide assure yourself that you are getting the protection.

By W. F. Fair, Jr. ..... Page 28

Watch Your Corrosion Control Program Closely

☐ Keep close tab on new pipe line performance. Careful advance planning eliminates many of the toughest corrosion headaches on the pipe line. After the system is installed, a complete set of records can cut costs.

By O. W. Everett ..... Page 33

Let's Look at Electrical Grounds

☐ A practical solution from a leading engineer provides adequate "grounding" facilities to avoid electrical arcs when handling crude and petroleum products. A more efficient answer is in using the buried pipe itself.

By W. H. Stewart ..... Page 37

Take the Mystery Out of Rectifiers

☐ Your modern rectifiers are designed to give top performance, and they will if equipment recommendations are followed. This explanation of basic operating principles, rating factors and construction features will serve as a guide.

By Wayne Johnson ..... Page 39

Digital Telemetering Proves Accurate and Reliable

☐ Early experience on Service Pipe Line Company's remote control stations proved successful. Transmission of operating data and supervisory control signals by a digital code promises several advantages for remote pipe line control.

By Max T. Nigh ..... Page 45

Are You a Good Supervisor?

☐ Are you a good supervisor? Through experience and counsel, pipe line management has devised definite standards to determine whether an employe is made of supervisory timber. Here is an interesting summary of 28 time-proven selection factors. ..... Page 57

REGULAR MONTHLY DEPARTMENTS

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PIPE LINE INDUSTRY published every month. Entered as second class mail matter July 9, 1954, at the post office at Houston, Texas, under the act of March 3, 1879.

A Time for Action

The tentacles of creeping socialism are pulling tighter. Within the past 60 days a varied assortment of federal groups have:

- Threatened government control of refining and production to get more oil for Europe.
- Launched at least three investigations into recent crude and gasoline price increases.
- Stepped up attacks on oil's marketing operations.
- Called in the FBI to check the industry's economic operations.

The oil industry can no longer treat these government slaps like a pesky pup that, if left alone long enough, will go away. The pup is turning vicious, and if not discouraged—or enlightened, may well bring an ignominous end to the oil industry as a private enterprise.

●

There is a way to discourage oil's critics, both in and outside government circles—an excellent way: *Present them, and the American public, with the facts—the reasons behind the actions.* It won't be easy to implement, but it must be done if the industry hopes to shake itself free of government control.

The facts and reasons must be given to every member of federal and state government—to every oil industry employe—to every company stockholder—to every resident of every community in which oil companies live—to every individual who pays the higher prices for gasoline.

These groups are entitled to the facts. The oil industry has the facts—and they more than justify the action. Now is the time to present them.

The first step is up to top management. Willingness to present the facts—reasons for presenting them—the facts themselves—directions for dissemination—all must come from the top. Industry action will be a direct reflection of the attitude of the policy makers.

Although incentive and direction must come from the top, an equal responsibility rests with the industry's two million employes. It is their responsibility to learn the reasons behind industry actions—to have the right answers when non-industry individuals and groups ask critical questions, or make statements about oil that are untrue.

In short, it is the responsibility of *every* individual in the oil business to take an active part in creating and maintaining public understanding. The future of the industry may well be determined by the way in which this responsibility is met.

●

To help in the presentation of the facts, PIPE LINE INDUSTRY has checked several reliable sources to compile accurate statistics which prove that oil's actions in the recent price increases were more than justified. The results are startling, as you will see when you read the eight-page supplement which accompanies this issue.

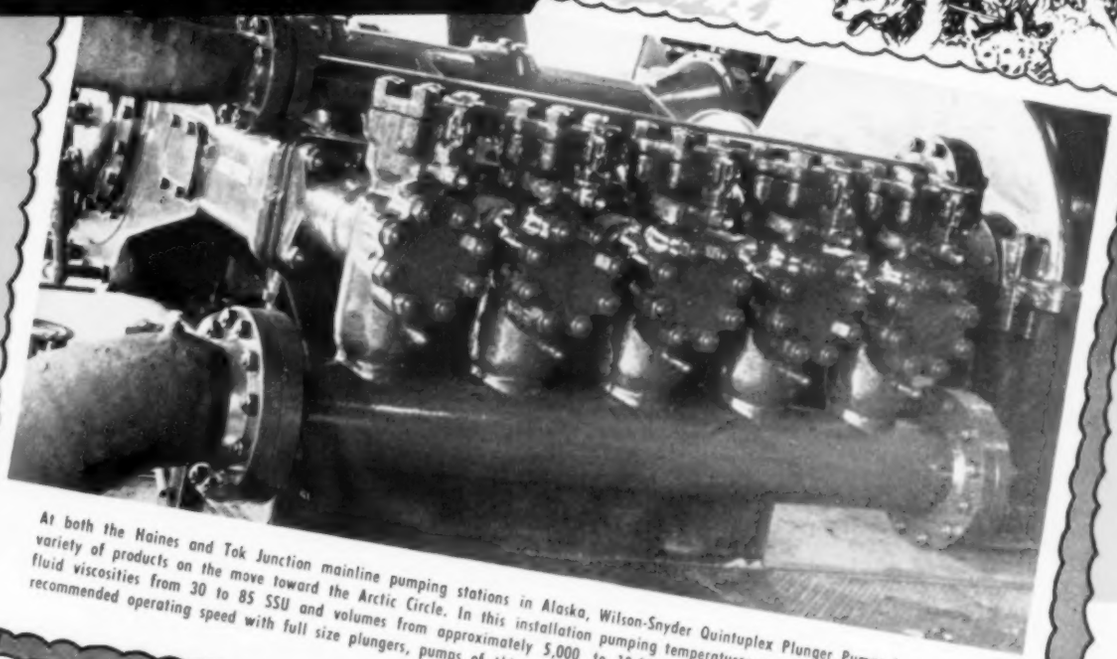
After you have finished reading oil's side of the story, please pass it on to a non-industry friend. It will take him but a few moments to realize that oil products are still the biggest bargain in America, compared with many products—despite mounting costs and decreasing reserves. If you would like more copies to send to individuals or groups, they are available at nominal cost.

No matter how you do it—help keep the oil industry free.

Now is the time for action.

Wilson-Snyder No. 558-P Quintuplex Plunger Pumps

...chosen for another critical pumping job!



At both the Haines and Tok Junction mainline pumping stations in Alaska, Wilson-Snyder Quintuplex Plunger Pumps keep a wide variety of products on the move toward the Arctic Circle. In this installation pumping temperatures may vary from 80 to —20° F, fluid viscosities from 30 to 85 SSU and volumes from approximately 5,000 to 10,000 bpd per pump at 1,200 psi. At maximum recommended operating speed with full size plungers, pumps of this type are capable of handling up to 17,500 bpd at 1,270 psi.

IN THE FIRST PUMPING STATION of the Alaska Products Pipe Line at Haines, Alaska . . . as well as at Station No. 3, some 450 miles up the line at Tok Junction . . . Wilson-Snyder Quintuplex Plunger Pumps were selected because only reciprocating, positive-displacement pumps can handle both light and heavy liquids, at wide viscosity and pressure variations, in summer and winter temperatures, at uniformly high efficiency.

THESE ARE THE PUMPS . . . that were designed specifically for difficult pipe line applications. The one-piece, fully-enclosed, rib-reinforced power frame provides a rigid support for the crankshaft, which is mounted in heavy-duty roller bearings. The fully-annealed, cast-steel fluid end with open-type fluid chambers, avoids differential pressures on internal walls.

PERFORMANCE – The working order of the five overlapping plunger strokes results in a smooth discharge pressure at all speeds. Large, streamlined fluid passages further minimize resistance and turbulence, contributing to high pumping efficiency.

MAINTENANCE – Horizontal pump construction with large stuffing box openings affords ready access for packing adjustments. Two-piece plunger construction facilitates installations of new packing when needed and plungers can be serviced separately. A combination splash and pressure system supplies ample lubrication to all power end working parts.

WHEN PUMPING PROBLEMS . . . are being analyzed, give your nearest "Oilwell" Pump Specialist an opportunity to quote on Wilson-Snyder pumps that will meet your requirements . . . . MOST ECONOMICALLY

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UNITED STATES STEEL

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■ W-S Forged Steel Fittings provide safe, tight connections for your small diameter, high pressure piping. In gathering lines . . . pump and compressor piping . . . instrument lines and other high pressure lines, 4" and under in diameter, W-S fittings protect you against costly down-time. They're drop-forged for extra strength and toughness—and they're safety-factor designed.

Watson-Stillman Fittings are available in screw-end and socket-welding types in carbon steel, stainless steels and alloy steels. Send for your copies of our informative catalogs.

Write to W-S Fittings Division, H. K. Porter Company, Inc., P.O. Box 95, Roselle, N. J.

HKP W-S FITTINGS DIVISION
H. K. PORTER COMPANY, INC.

PIPE LINE INDUSTRY

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WORLD OIL and **THE COMPOSITE CATALOG** for the drilling-producing-pipe line industry.

PETROLEUM REFINER and **THE REFINERY CATALOG** for the refining-natural gasoline-petrochemical industry.

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Indexed by Engineering Index and Industrial Arts Index

How a D2 fits into your spread

THE efficient, versatile CAT* D2 Tractor is an ideal unit for pipe-line work in confined quarters or on busy city streets. Not only is it extremely maneuverable, but it is designed to give you high production.

Gragg Canada, Ltd. of Toronto is using a D2 with a No. 2A Bulldozer on a 21-mile natural gas line of Consumer Gas Co. in metropolitan Toronto. It is being used principally for backfilling.

Texas Allen, general manager, says, "This machine stands up well under very rough working conditions."

It is engineered to give you top performance—from track bolts to drawbar pins. The D2 has aluminum alloy main and connecting rod bearings; heavy-duty track rollers; heat-resistant alloy steel valves, high-strength "Zerol" bevel gears; a rugged five-speed transmission. In any climate, you can be sure the D2 will start when you need it because it has the exclusive Caterpillar all-weather starting engine.

And now you can order the D2 equipped with the new Caterpillar field-tested oil clutch. If your job is tough on tractor flywheel clutches, you'll find the new clutch increases dependability and reduces service and maintenance costs. Clutch adjustments are rarely required and disc replacements are needed no more frequently than engine overhauls.

Behind the D2—like all Caterpillar-built equipment—stands an army of expert service personnel. You'll find them, and complete parts and service facilities, wherever the pipe takes you.

So see your Caterpillar Dealer when you're figuring machine and equipment needs for your next job. He has the units to fit your requirements *exactly*. And he'll demonstrate on your job. Call him today.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR*

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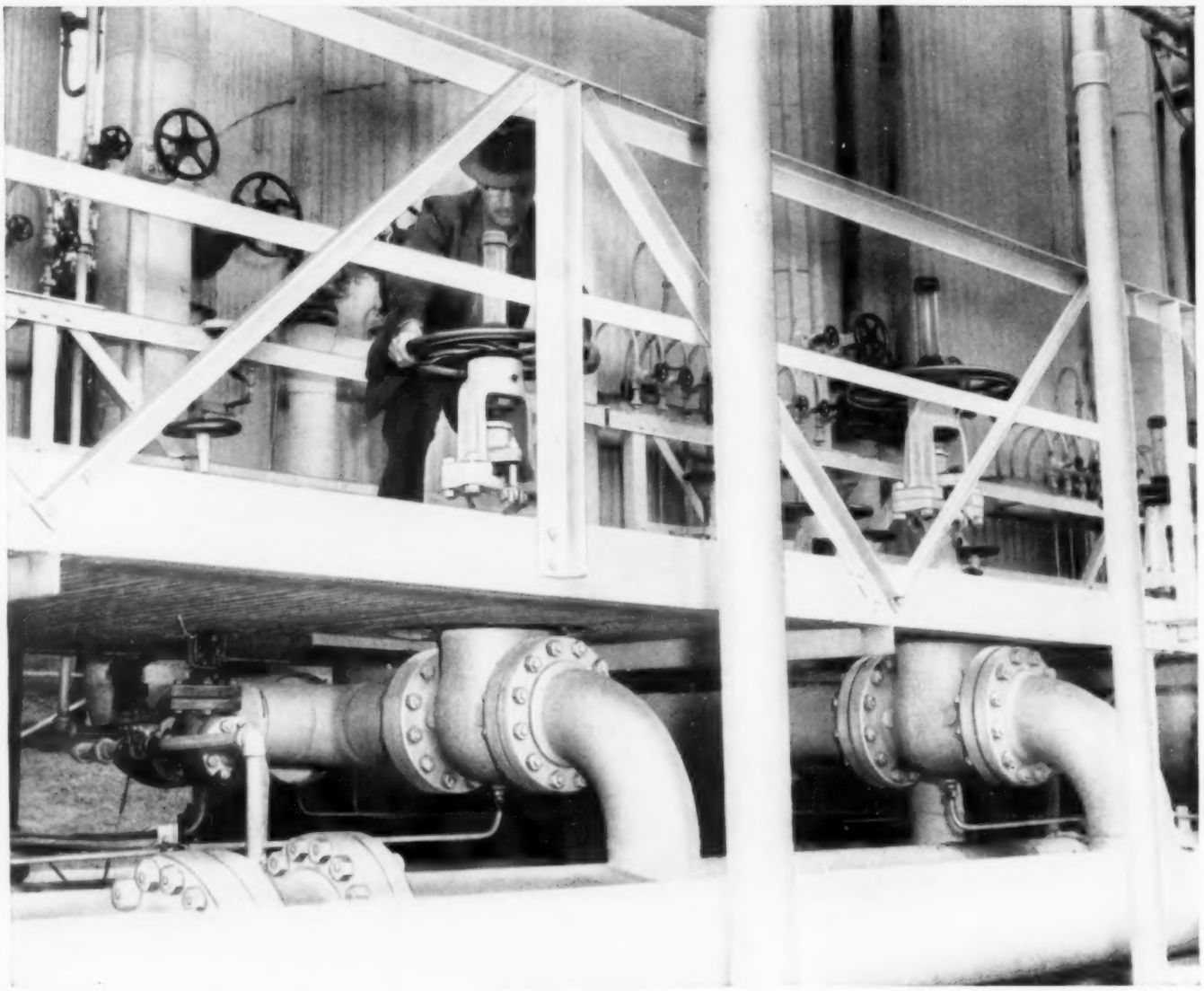
**NAME THE DATE...
YOUR DEALER
WILL DEMONSTRATE**



Double Block Protection at Half the Cost —with Crane Flexible Wedge Disc Gate Valves

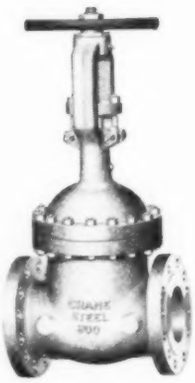
There are real savings in this installation.

The main valves you see in the photo are Crane 33XU steel gates modified with flexible disc—8-, 6- and 2-inch—on the dehydrator in the Phillips Pipeline Company pump station at Borger, Texas. Moisture is removed from the product here, using butane at 450° F. The setup is part of Phillips' 8-inch Borger-Chicago product pipeline, looped in 1951 to handle dissimilar products.

Design features of the Crane flexible wedge disc gate valves are cutting costs across the board. With the flexible disc, positive seal is assured on the upstream as well as downstream side. Each valve does the work of two with solid wedge disc.

Tapped opening is provided in bottom of body which permits bleeding while main valve is closed. Valve and piping costs are cut in half; the operator has only one valve to handle instead of two.

Crane flexible wedge disc steel gate valves can be furnished in sizes 2- to 12-inch, pressure classes up to 1500 lb. Get the facts from your local Crane Representative, or write to address below.



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NOW in a full range of sizes and capacities

for 2" to 8" lines — 100 to 1,300 gpm
Working pressures to 150 psi

- For all new or existing *BiRotor* Meters
- Accurately measures quantity delivered
- Automatic meter operated volume shutoff
- Cushioned closing avoids shock damage

701

Whether you're considering a new installation — or converting existing Brodie *BiRotor* Meters to *Automatic Preset Quantity Control*—Brodie smooth *Shock-free Quantrol* shutoff now offers a full range of sizes and capacities. You gain safe, positive volume control that eliminates shock damage to piping, pumps and other equipment. Brodie *Quantrol* conversion kits permit quick easy change-over. When you specify, indicate *new* or *existing* meter installation requirements. Contact Brodie *first* for the last word in petroleum metering.

BRODIE ALL-STEEL BiRotor TRUE-ROTARY METERS

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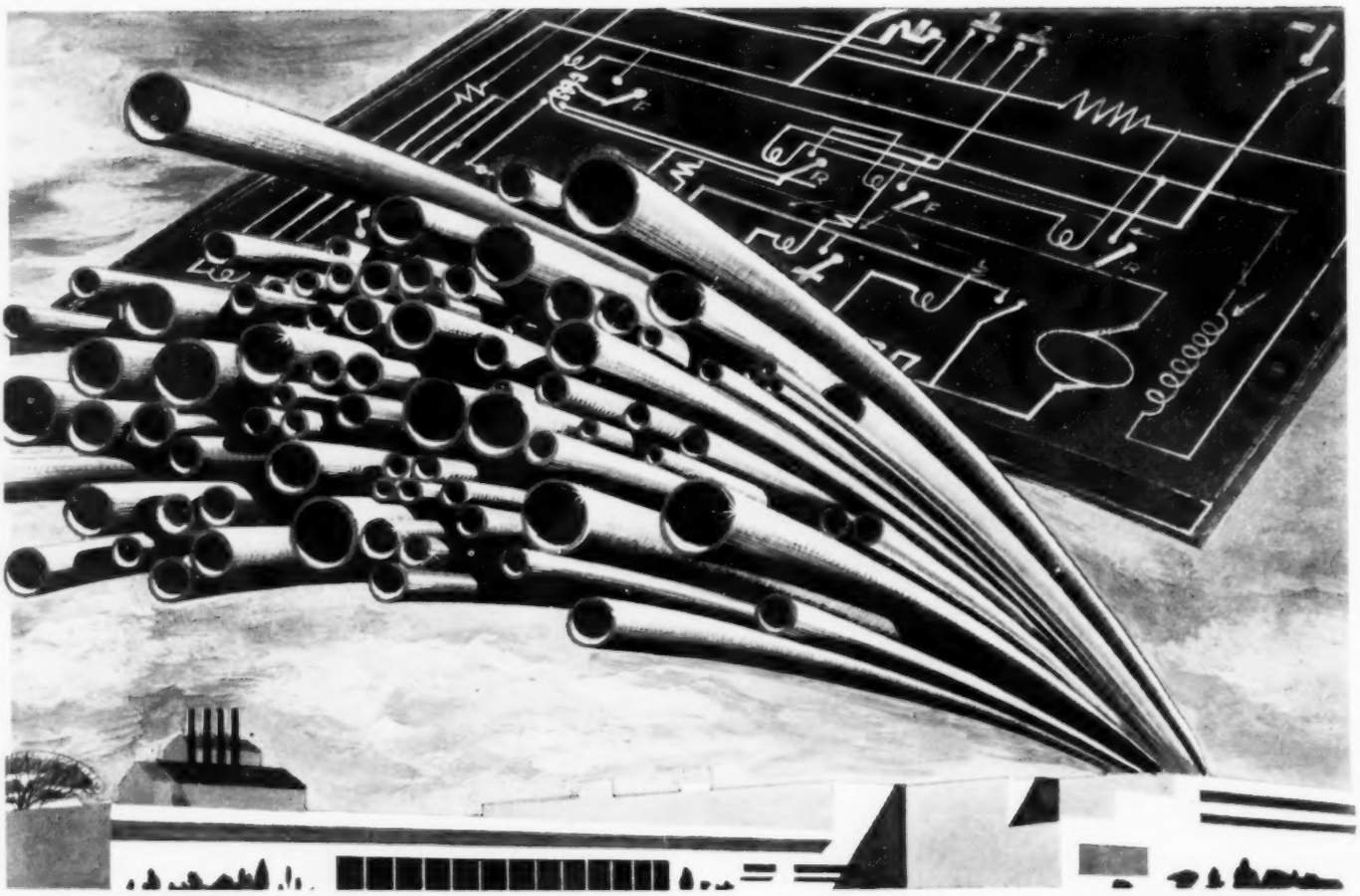
Naugatuck KRALASTIC



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KRALASTIC electric conduit cuts costs 51%

15,060 feet of AMCO PLASTIC CONDUIT* were laid in ditches and covered with 53 yards of concrete in 116 man-hours.

Extruded of lightweight KRALASTIC®, Amco Pipe made it possible for one man to carry on his shoulder, and distribute, as much as 1,000 feet of 1½" conduit... eliminating the need for handling equipment. After laying all 24 lines in a ditch, one man could solvent weld every connection in 20 minutes... eliminating making and connecting threaded assemblies.

Naugatuck's KRALASTIC is an unusual rubber-resin blend. And because its properties are far superior to wood, metal and other plastics, KRALASTIC offers practically unlimited possibilities. For more about this tough, durable plastic material, and the advantages it offers you, write to us on your company letterhead TODAY.

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Youngstown's "big 5"

HELP MAKE ANY OIL OR GAS LINE INSTALLATION EASIER, QUICKER, LOWER IN COST

Here are the "Big 5" reasons why Youngstown Electric Weld Line Pipe is your best buy:

1. It bends readily
2. Wall thickness is uniform
3. Line up characteristics are excellent
4. Weldability is outstanding
5. Long lengths save you time and trouble

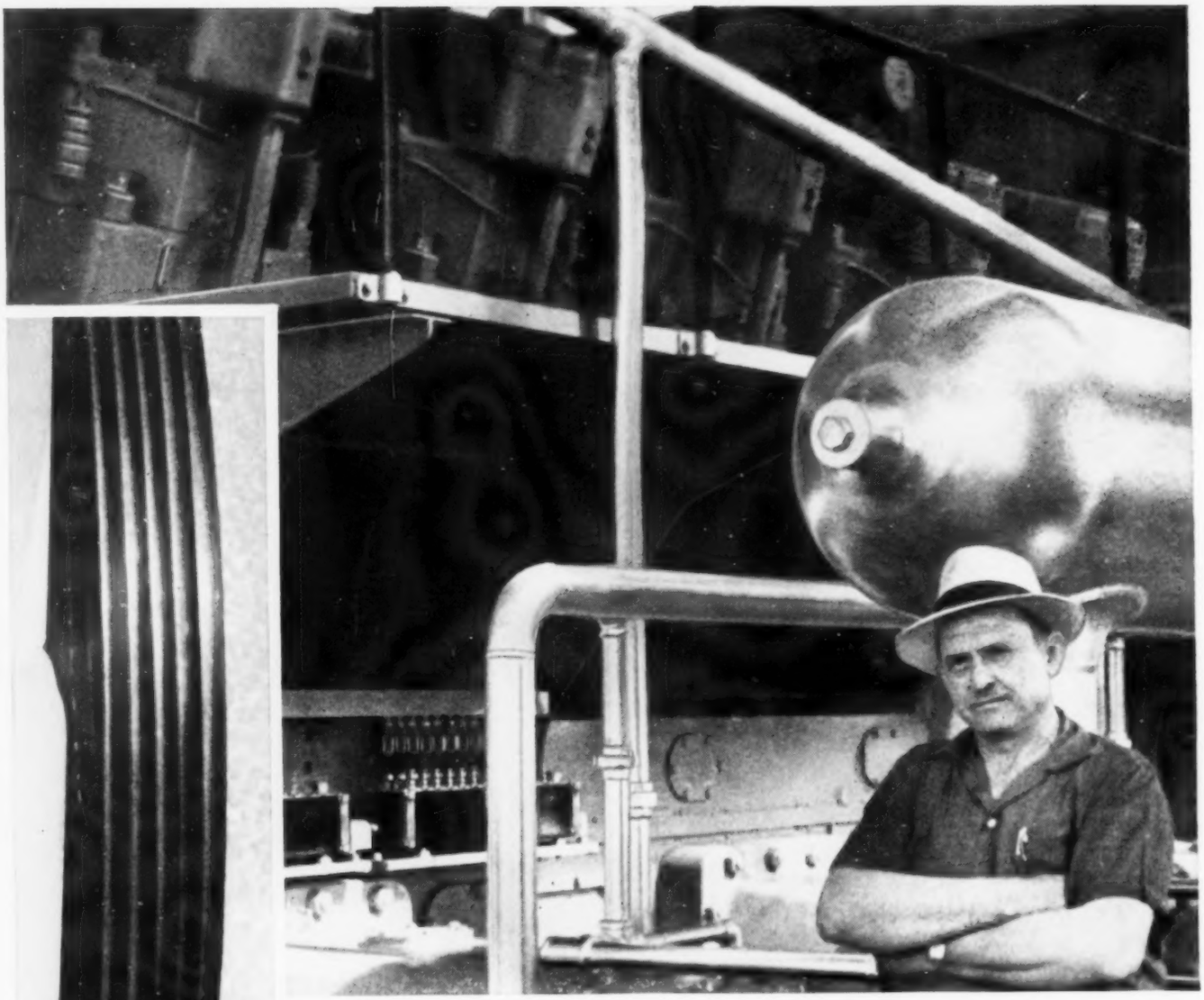
Why does the welder like to work with Youngstown Electric Weld Line Pipe? The answer is apparent! Youngstown Electric Weld Line Pipe is designed for easy welding The same physical and chemical characteristics that make for perfection in welding at the mill also contribute to efficient, dependable welding in the field. Freedom from delays in welding, speed up installation of the pipe line—reduces contractors' costs.

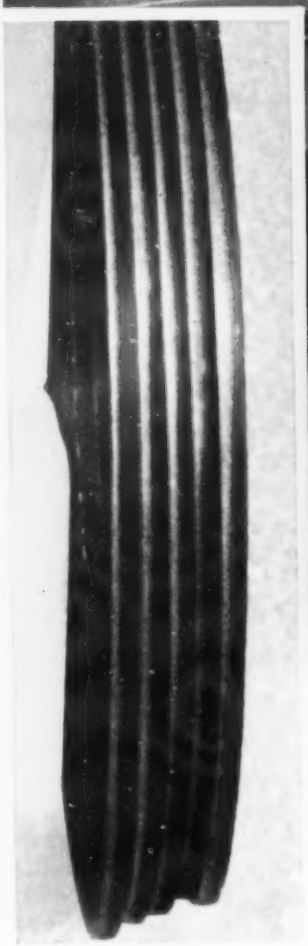
Youngstown ELECTRIC WELD LINE PIPE

QUALITY YOUNGSTOWN SERVICE

THE YOUNGSTOWN SHEET AND TUBE COMPANY *Manufacturers of Carbon, Alloy and Yoloy Steel*

General Offices - - - Youngstown 1, Ohio.





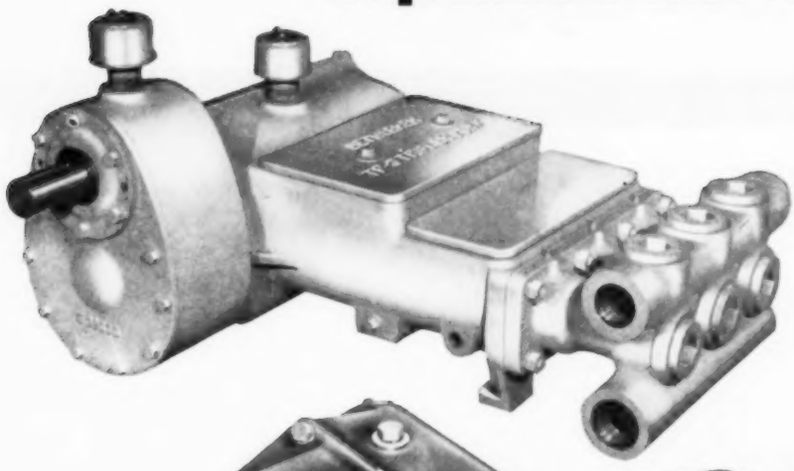
Long, Long Wear and Completely Dependable Performance from

Pedrick PISTON RINGS

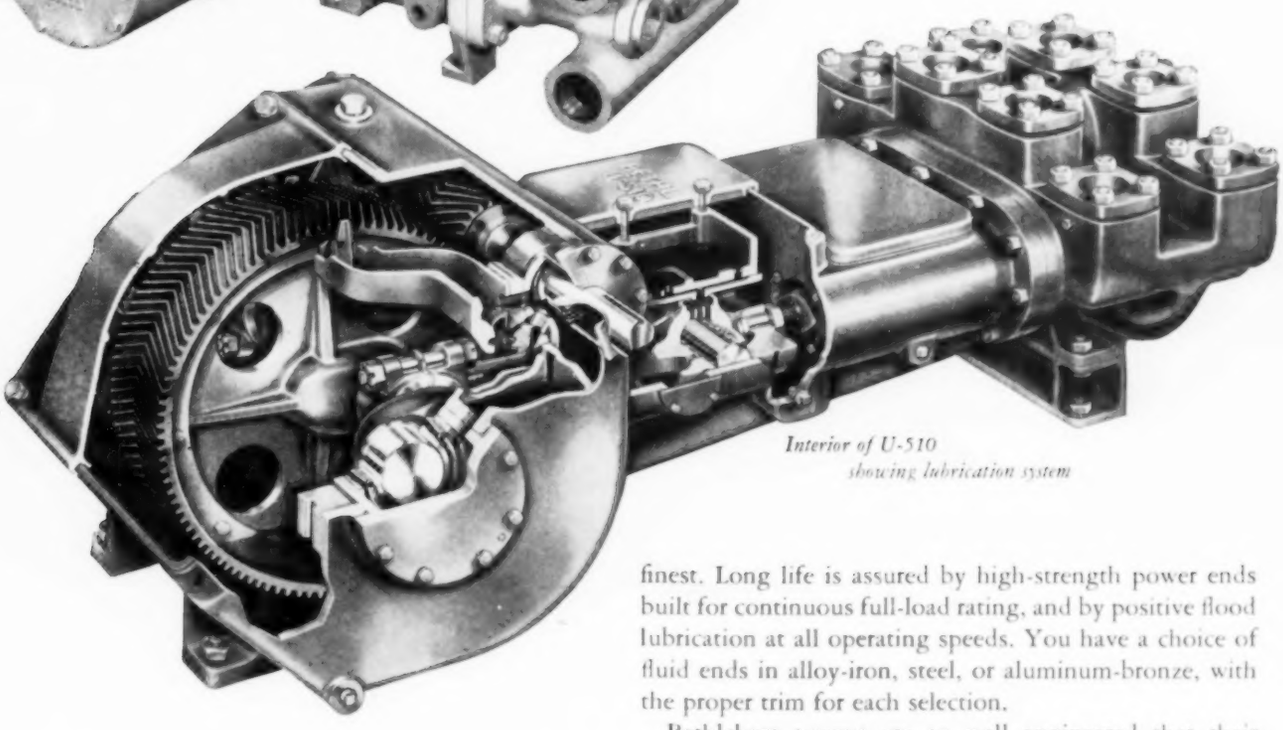
The Michigan-Wisconsin Pipe Line Co. is another user of Pedrick Engineered Sets of piston rings to prove this. E3905 Sets are installed in Cooper-Bessemer GMW-10 natural-gas engines at the Edgar G. Hill compressor station at Guymon, Okla. Harry Crouch, superintendent, stands beside one of these engines in the picture above. The picture to the left is from an unretouched photo of five of the taper-face compression rings recently removed from the engine during routine maintenance. The bright surface is the area of wear. Note that it does not go even half way across the face of the rings after 27,000 hours of steady round-the-clock operation at full load! That's less than .0025 in. radial wear. The Pedrick *conformable* Formflex oil rings in this installation showed equally low wear. The rings still are in condition to give more than double the length of service already achieved! If you want to be more sure of minimum wear of rings and cylinder liners, if you would like to cut your lube-oil consumption to the bone, if dependability of performance under full load without interruption is important to you, then use Pedrick Engineered Sets of piston rings in your engines from now on.

WILKENING MANUFACTURING CO., Philadelphia 42 and Toronto 2

Pick your "Handy Man" from this expanded line of power pumps



TP-3 Triplex Pump



Interior of U-510 showing lubrication system

Bethlehem now offers five distinct sizes of general-service pumps, so that it's even easier to pick just the right unit. We doubt that you've ever seen a line of pumps with so much versatility. Each is a "handy man"—a pump that can readily be adapted for several different kinds of work.

Does your job involve waterflooding? Salt-water disposal? Pumping crude oil in gathering systems or pipe-line service? Pumping mud or water for the drilling rig? If the answer is yes, there are Bethlehem units that will fit perfectly into your engineering plans.

You can bank completely on the quality of these pumps. Components are exhaustively tested. Materials are the finest. Long life is assured by high-strength power ends built for continuous full-load rating, and by positive flood lubrication at all operating speeds. You have a choice of fluid ends in alloy-iron, steel, or aluminum-bronze, with the proper trim for each selection.

Bethlehem pumps are so well engineered that their salvage value is always high. We feel certain that their many advanced features will interest you. If you will write or call, our people will gladly furnish complete information.

FIVE SIZES, DUPLEX AND TRIPLEX

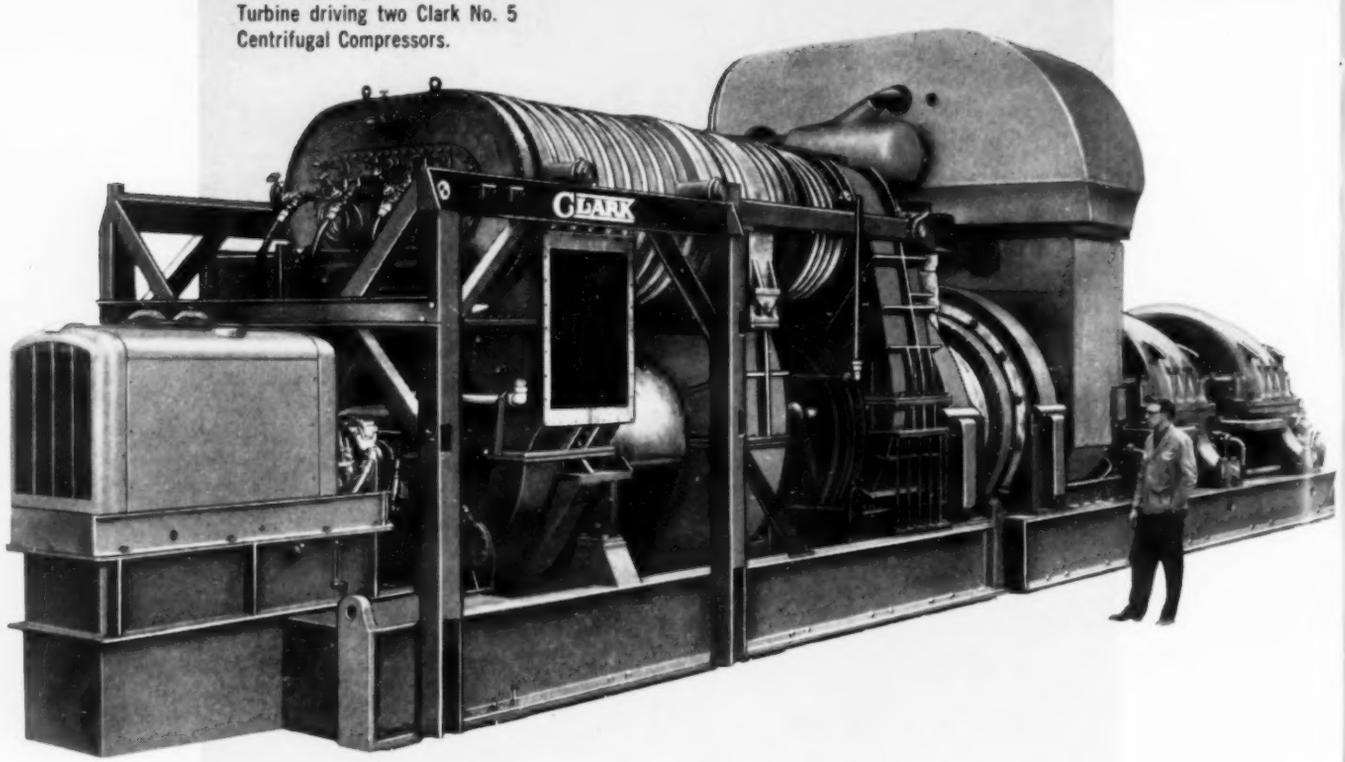
Model	Type	Plunger Load, lb	Input Hp	Bore & Stroke, in.
U-33	Duplex	2400	14 @ 180 rpm	1¾ to 3 x 3
UA-46	Duplex	5000	40 @ 120 "	2½ to 4 x 6
U-510	Duplex	12000	100 @ 75 "	3 to 5½ x 10
TP-3	Triplex	3580	22.4 @ 250 "	1¾ to 2¼ x 3
TP-4	Triplex	5000	42 @ 250 "	2 to 4 x 4

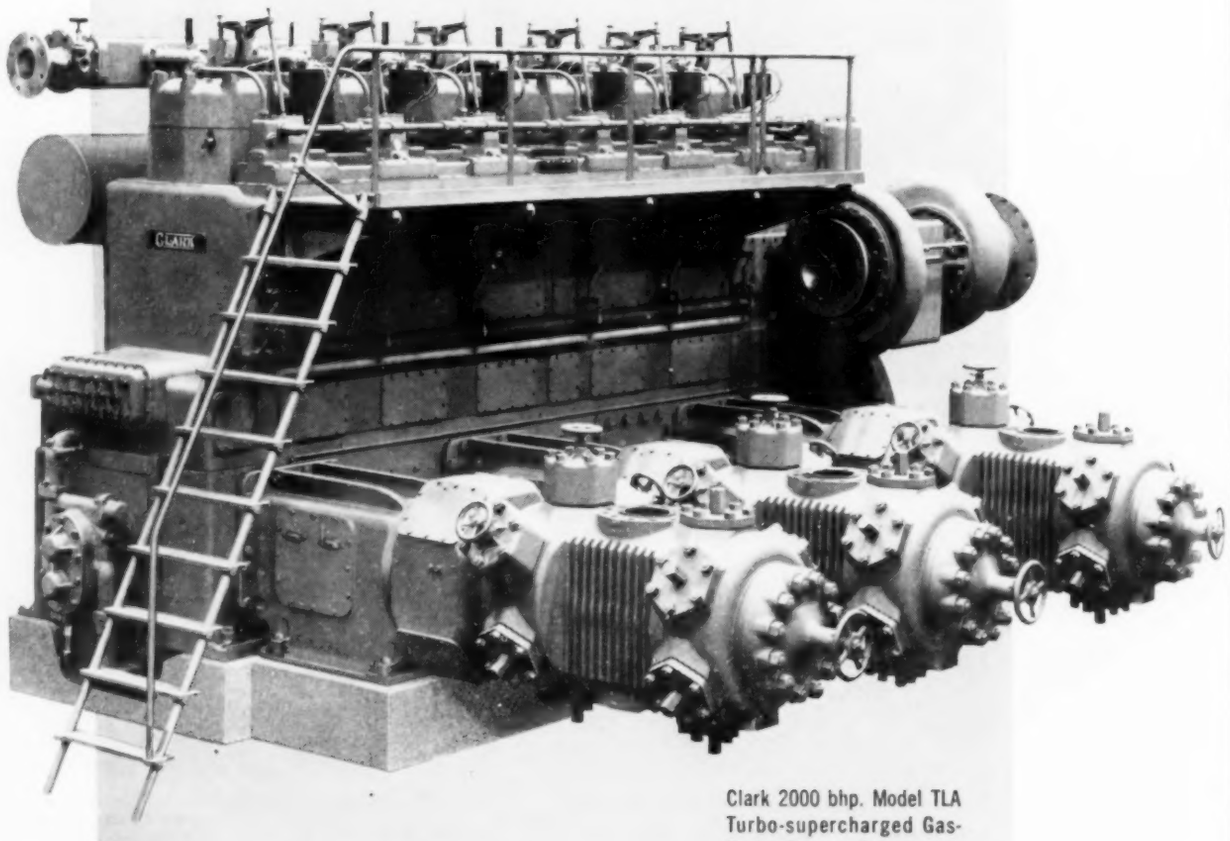
BETHLEHEM SUPPLY COMPANY

General Offices: 21 E. Second St., Tulsa, Okla.
West Coast Headquarters: Los Angeles, Calif.
Export Distributor: Bethlehem Steel Export Corporation
25 Broadway, New York, N. Y.

BETHLEHEM SUPPLY

Clark 8500 bhp. Model 302 Gas Turbine driving two Clark No. 5 Centrifugal Compressors.





Clark 2000 bhp. Model TLA Turbo-supercharged Gas-Engine-Driven Compressor.

Gas turbines or engines?

With Clark you eliminate

Prejudice

Gas turbine-driven centrifugal compressors or reciprocating compressors . . . you can get both types from Clark

Prejudice can add substantially to the cost when selecting compressors. At Clark, we build both gas turbine-driven centrifugal compressors and gas-engine-driven reciprocating compressors. In both instances the compressors and drivers are the most modern available.

Our chief concern is to be certain that you obtain the proper unit for your specific installation. This is where our experienced application engineers enter the picture. Both types of units have certain characteristics that may make one or the other best for your particular use. An unbiased opinion, after a careful examination of all the facts and conditions, is vitally important. Clark is the only company that can give you an unbiased opinion because Clark is the only company that builds reciprocating and centrifugal compressors in addition to gas turbines.

Clark application engineers will be pleased to help you determine the right type of compressor and driver combination for your next application.

CLARK BROS. CO., OLEAN, NEW YORK

One of the Dresser Industries

Offices in Principal Cities Throughout the World

CLARK®

Centrifugal Compressors
Reciprocating Compressors
Gas Turbines

For fast, on-time pipeline trenching Bucyrus-Erie 22-B Dragshovel

When tough-going threatens your trenching schedule—that's when a Bucyrus-Erie 22-B dragshovel really pays off. Here is true rugged construction to match high-speed digging power—a combination that keeps jobs on schedule mile after mile.

That rugged dependability is there because it's built right in to start. Research, engineering and manufacturing facilities unsurpassed in the industry are back of every 22-B that goes to work.

You can see this leadership in the outstanding features of the 22-B: tapered dipper with high side cutters and tough teeth loads full and fast and dumps clean and quick . . . strong cambered boom supplies extra, time-saving reach . . . smooth, vibration-free control responds to fingertip touch to help operators deliver rapid work cycles. And most important, a 22-B is built to stay on the job with minimum maintenance.

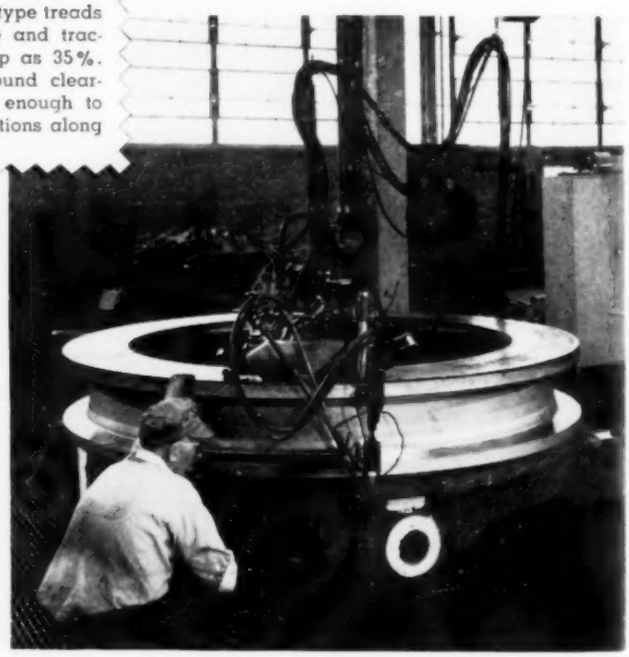
Put a 22-B dragshovel to work on your next job and watch it set the pace on trenching. Your Bucyrus-Erie distributor will give you all the facts on this dependable ¾-yd. machine.

292E56

The deep grousers on tractor-type treads of the 22-B provide the bite and traction to climb grades as steep as 35%. These treads also raise ground clearance to 20¾ inches — high enough to clear rocks and other obstructions along the right-of-way.

Bonus Quality

is built into every part of a Bucyrus-Erie machine. For example, this automatic machine is flame-hardening the lower path for the hook rollers to insure long life and low maintenance.



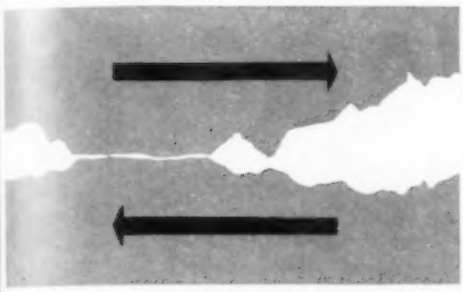
BUCYRUS ERIE

South Milwaukee, Wisconsin

WHY VALVE LUBRICATION SAVES MONEY

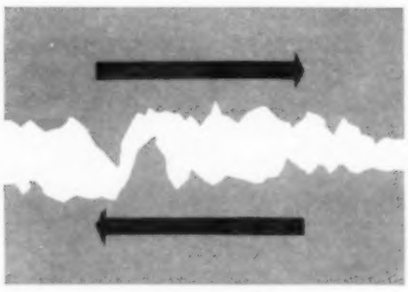
TROUBLE STARTS WHEN METAL RUBS METAL...

Under the microscope, metal that appears mirror-smooth to the naked eye shows as sharp mountains and deep valleys. This roughness, combined with the heat and pressure of metal-to-metal rubbing, causes valve trouble in the following ways:



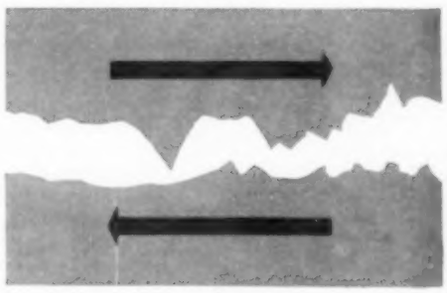
STICKING

"Cold Welding" occurs when friction or pressure welds the peaks together. The result: sticking.



SHEARING

The "hills" of one surface gouge into the hills of the other surface causing further sticking and scoring.



PLOWING

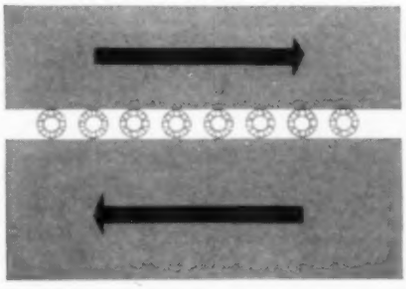
If one surface is even slightly harder than the other, the hard peaks act like a "plow". Leakage soon results.

BUT, WITH ROCKWELL-NORDSTROM VALVE LUBRICATION...

metal-to-metal contact is eliminated. Here's what happens when metal-to-metal surfaces are lubricated:

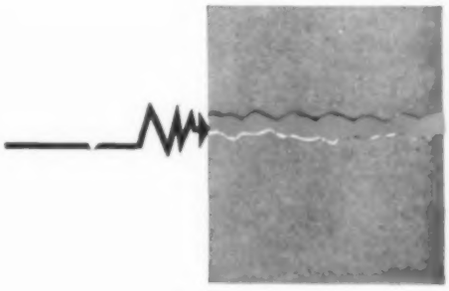
SLIDING

Lubricant prevents friction heat, eliminating danger of cold welding and assuring easy movement.



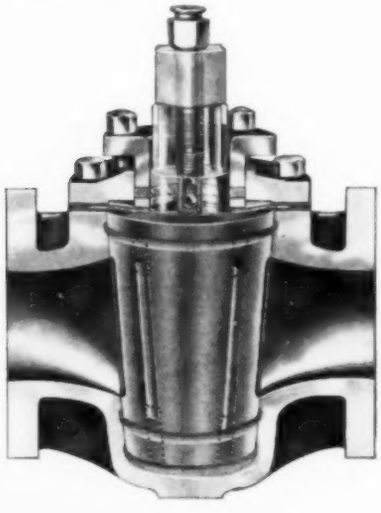
ROLLING

Lubricant becomes millions of tiny bearings . . . metal surfaces actually never come into contact with one another.



SEALING

Pressurized lubricant forms an impenetrable, continuous seal against leakage.



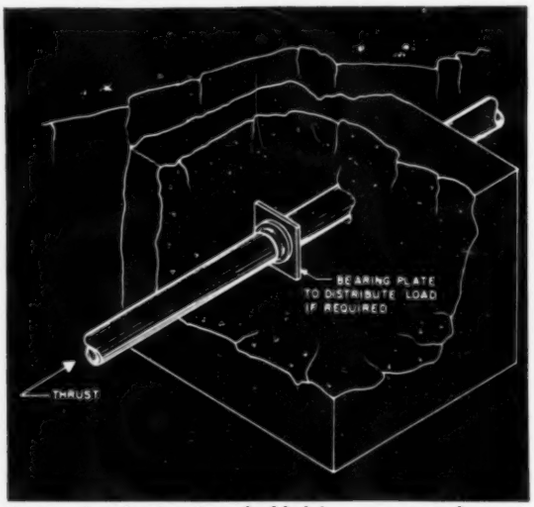
LONGER LIFE, LOWER COST, better valve service results when you specify Rockwell-Nordstrom lubricated plug valves. Notice in the drawing at the left how lubricant protects all the working surfaces and seals positively against leakage. Since lubricant eliminates adhesion, shearing and plowing, Rockwell-Nordstrom valves cost you less to use . . . year after year. Rockwell-Nordstrom valves are available in a complete range of sizes and pressure ratings to answer every flow control need. They cost no more to buy, often less, than ordinary valves. See your nearest supplier or write Rockwell Manufacturing Company, Pittsburgh 8, Pa. for complete details.

Canadian Valve Licensee: Peacock Brothers Limited

ROCKWELL-Nordstrom VALVES

LUBRICANT SEALED FOR POSITIVE SHUT-OFF

Close-up of TUBE-TURN Anchor Forging after butt-welding into 20" line.



How anchor forging is embedded in concrete and transmits pipeline thrusts to the structure.

Completed installation, showing reinforcing structure, ready for concrete.

Hold that line

with the new TUBE-TURN Welding Neck Anchor Forging*

Installing TUBE-TURN Anchor Forging in 20" gas line of Texas Gas Transmission Corp., near Eunice, La. Hubs are butt-welded to pipe ends.

High operating pressure, and expansion forces due to temperature change can team up to produce end thrusts in pipelines of 1,000,000 lbs. or more! Lines may be overstressed and expensive equipment damaged.

TUBE-TURN* Welding Neck Anchor Forgings provide an answer to this problem. Available for pipe sizes 6" through 36"... for operating pressures up to 1200 psig and temperature changes up to 90° F.

In writing for information, provide this data on your application: Size, wall thickness and material of matching pipe, design pressure and temperature, special requirements.

TUBE TURNS LOUISVILLE 1, KENTUCKY

A Division of National Cylinder Gas Company

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Detroit • Atlanta • New Orleans • Houston • Midland Dallas • Tulsa • Kansas City • Denver • Los Angeles • San Francisco • Seattle

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TUBE-TURN

*"TUBE-TURN" and "tt" Reg. U. S. Pat. Off.

PIPE LINE PANORAMA

Three Lines for Four Corners? . . . Area where Utah, Colorado, New Mexico and Arizona meet is fast becoming hottest center of pipe line activity. In recent weeks 11 companies approved three pipe line projects to handle minimum of 135,000 bpd of Four Corners crude. Projects include:

- 16-inch, 600-mile line from Aneth area (Utah) and Bisti area (New Mex.) to Los Angeles. Participating companies: Standard of Calif. (25%); Shell (25%); Gulf Oil (20%); Continental Pipe Line (10%); Richfield Oil (10%); Superior Oil (10%). Cost: $50 million. Initial Capacity: 60,000 bpd. Shell will build and operate the line.
- 16-inch, 515-mile line from Four Corners area to Texas-New Mexico Pipe Line's Jal, New Mex. pumping station. From there, crude could be shipped to Mid-Continent, Gulf and Southwest areas. Owners: Texas Company, Sinclair Pipe Line, Tidewater, Empire Gas and Fuel (Cities Service). Initial capacity: 50,000 bpd.
- 10-inch, 300-mile line to carry Bisti and Aneth crude to Salt Lake City was approved by Northwest Pipe Line, Pacific Northwest subsidiary. Cost: $20 million. Initial capacity: 25,000 bpd.

Latins Lay Aluminum Line . . . Colombian Petroleum will lay 6-inch, 42-mile aluminum line from Tibu field to Rio de Oro tank farm in eastern Colombia—the longest line of its kind laid to date. Will weigh one-fourth as much as comparable steel pipe. Company expects to have line completed and in operation full year ahead of time it would take to get and lay steel pipe.

Plot Thickens in Middle East Pipe Line Quandary . . . Five U. S. and four foreign oil companies are meeting in London to discuss Iraq Petroleum's recent survey of possible 1200-mile pipe line system from Kuwait through Iraq and Turkey to Mediterranean—thus by-passing Syria. One alternative includes two parallel 34-36 inch lines—one for light and the other for heavy crudes.

Israel is rushing to completion its 8-inch, 150-mile line from Eilat at the head of Gulf of Aqaba to Beersheba. The line will be completed this month. Capacity: 50,000 bpd. **If Israel can obtain free navigation** through Gulf of Aqaba, plans will continue to build 30-inch line from Eilat directly north through Israel to Tel Aviv on the Mediterranean. Bypassing Suez, it would be only Middle East line not passing through Arab countries.

New Gas Bill Gets Boost . . . FPC has suggested five major changes in Natural Gas Act which it says "are not inconsistent" with new gas bill drawn up by oil and gas leaders. Changes include:

- Establishment of new gas pricing standard that will eliminate required use of rate-base pricing method.
- Elimination of certificates of public convenience and necessity for natural gas producers.
- Same treatment for independent producers and interstate gas pipe line producers concerning prices and evaluation of natural gas.
- Elimination of sales contract clauses between independent producers and interstate pipe line companies which allow price changes for purchaser due to changed prices on gas resold by purchaser; and different payment, or payment offer, by purchaser or other purchasers to seller or other sellers.
- Elimination of cost and revenue consideration for other products obtained in conjunction with natural gas production, including oil and liquid hydrocarbons.

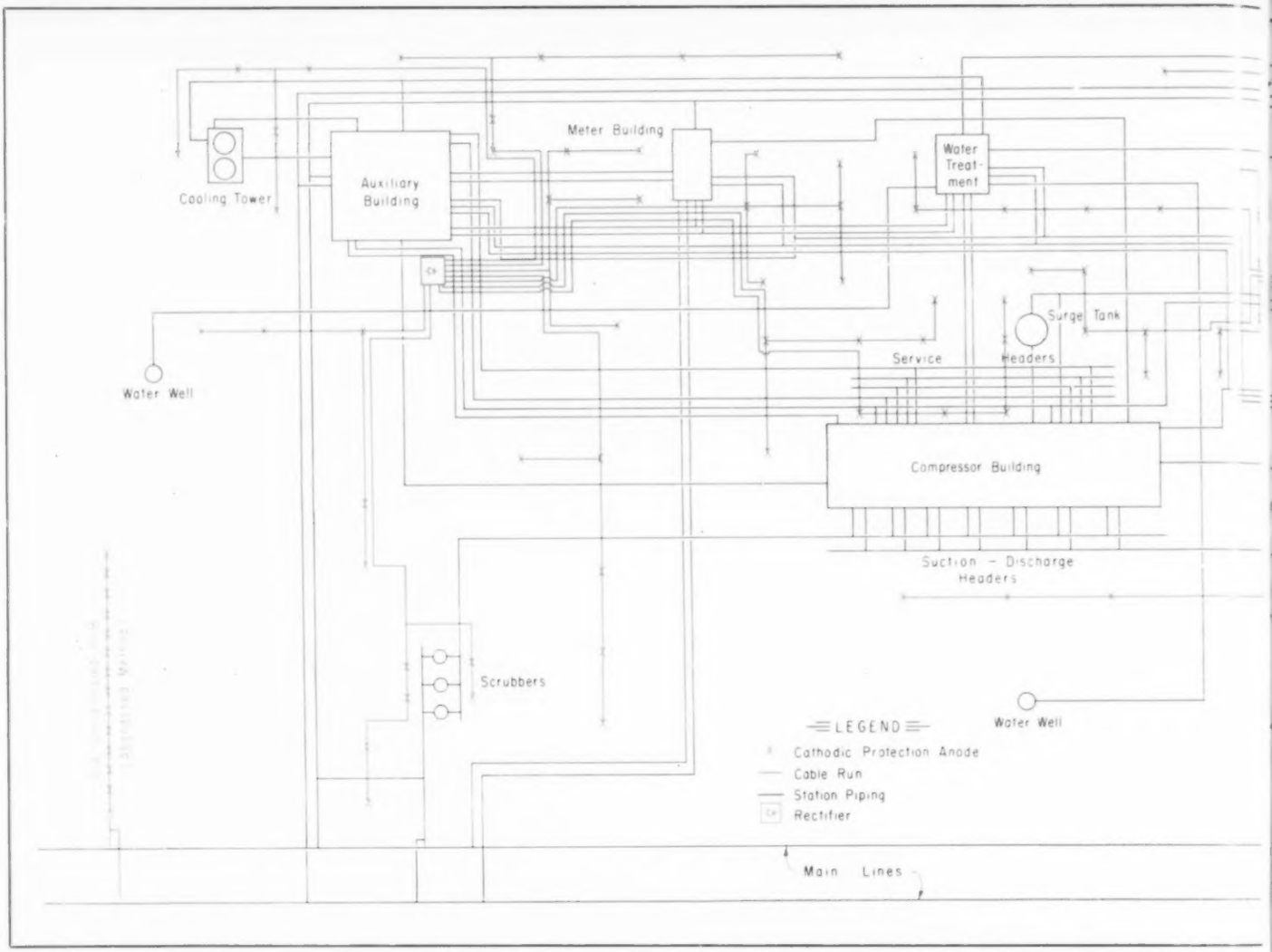


FIGURE 1—Typical distributed anode system for protecting compressor station piping. Anodes located at "boxes" in buried piping grid provide effective distribution of current. Cable runs are generally limited to five or six anodes, each run originating at the rectifier.

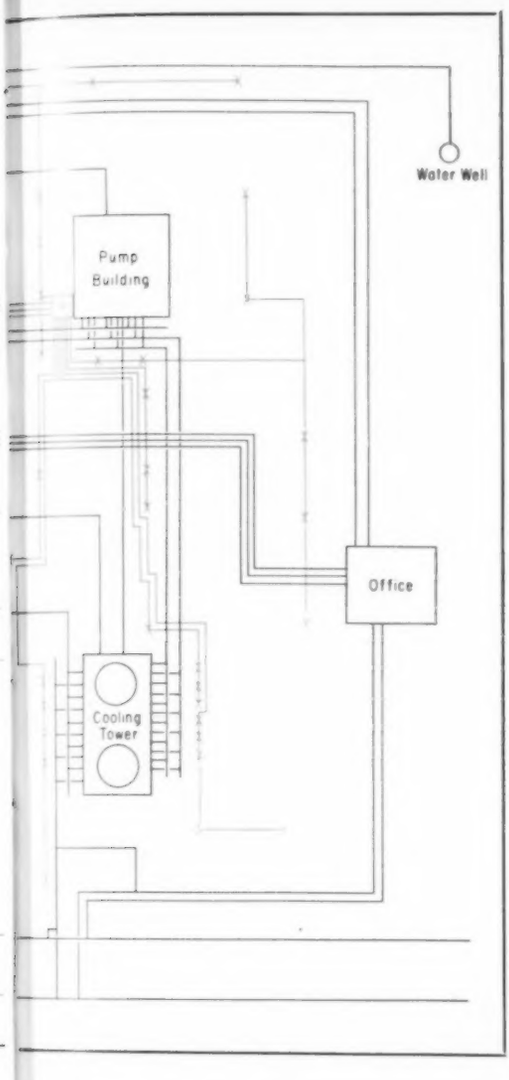
Properly Placed Anodes Protect Station

Good design calls for an anode to supply current to every "void" in buried piping grid. Station personnel are key to effective installation and maintenance of system.

By R. G. RANSOM
Tennessee Gas Transmission Company
Houston

EARLY CATHODIC protection systems at Tennessee Gas Transmission Company compressor stations used large concentrated impressed current ground beds on the edges of station yards. These ground beds provided current not only to the cross-country transmission lines but also to the majority of lines within the plant. But as stations grew in size and complexity, protection was no longer being furnished to piping inside the plant. Distributed anodes were installed to improve protection.

Pipe-to-soil voltage measurements indicated that most of the protective current formerly was being "absorbed" by the yard piping on the outer extremity of the station. First attempts to correct this utilized anodes installed in an abandoned water well within



Piping

the plant. From here the ground bed could "see" all of the yard piping from below. Later this arrangement became inadequate because of station expansion. Also the amount of protective current obtained varied widely with annual chages in salt content and height of water level in the well.

In 1951 the Corrosion Engineering Department first began using a ground bed arrangement wherein anodes were distributed throughout the piping system. These systems placed protective current in areas which were not reached from ground beds outside the piping maze. Impressed current type anodes were chosen over galvanic types because of the lower over-all cost for a system of this size.

TGT's first such installation was built at a station in South Texas. Based on early results there, a second plant of much larger size was surveyed and a distributed anode system was installed. After detailed pipe-to-soil voltage surveys were made through the station yards, the distributed anode system was considered to be successful. Subsequent drop in leak frequency has proved the method to be very effective.

Installed in Grid "Voids." The distributed anode system as used by TGT involves the placement of anodes throughout the plant yard in "holes" or "boxes" left in the piping grid. In very congested areas, anodes are placed along and parallel to a multiple run of piping.

Anodes are connected to cable runs that fan out from one or more central rectifiers. Multiple cable runs reduce the current per cable and minimize the number of anodes lost in case of a cable failure.

Simplify Trouble-Shooting. A junction box, either above ground or below ground, is used at each anode or closely spaced group of anodes. All cables in a ditch are brought into each junction box, though not necessarily terminated there. Use of such multiple runs and junction boxes greatly simplifies the location of trouble in either an anode or cable run.

All cable runs are terminated in a large junction box at the rectifier. Shunts provide for measuring the current drain in each section of the ground bed.

Good Design Is Key. Several practices are taken as a basis for designing the distributed anode installation at TGT's compressor stations.

First, prepare a general piping plan showing all buried piping of any kind. Make notation as to size, use and type (i.e., black or galvanized pipe, welded or coupled, etc.). Show also any buried metal structure that cannot be separated from the piping such as reinforcing and pilings in and under building or equipment foundations and pipe supports.

Make an on-the-ground check to

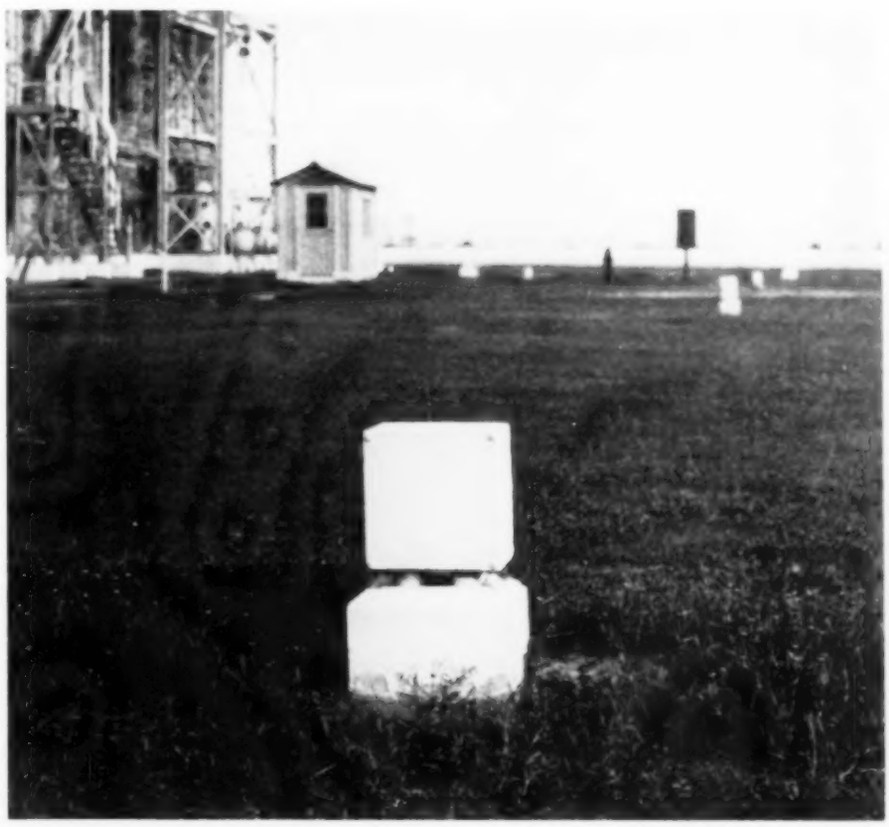


FIGURE 2—A junction box used at each anode, or "cluster" of anodes make leads and cable run terminals accessible for tests. Junction box connections eliminate costly splices and simplify future maintenance.

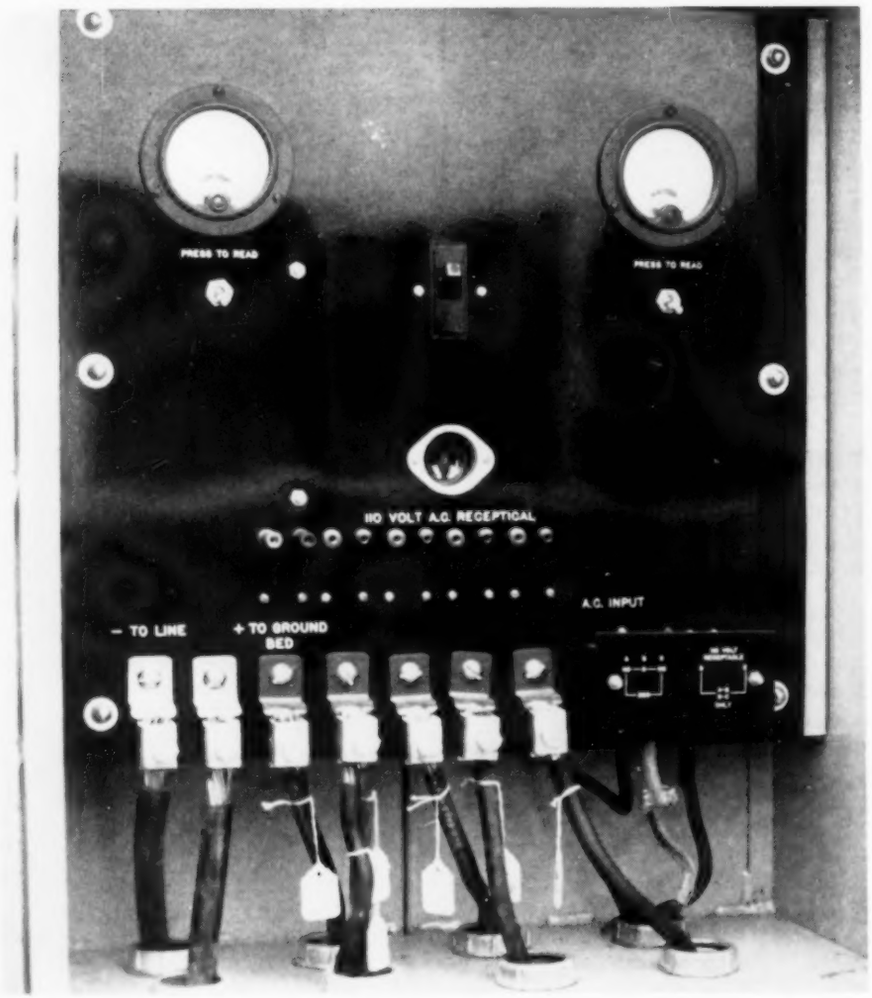


FIGURE 3—Cable runs are terminated at a large junction box at the rectifier. Shunts are provided for measuring current in each section of the ground bed.

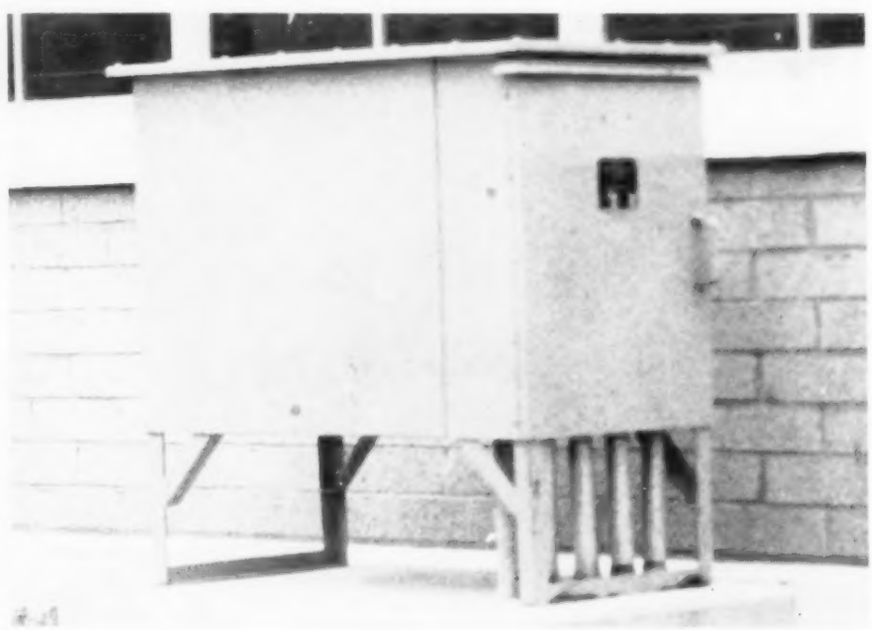


FIGURE 4—Rectifiers are generally installed at a central location near a building clear of work areas. From here cable runs radiate to several distributed anode beds.

verify every detail. Station maintenance foremen should be on hand for this check to identify changes made during maintenance work, spot ditch lines and limits of the various types of pipe, and offer other advice. Coating history should be checked and a maintenance man can often remember instances of adverse construction conditions. Such information will aid in estimating present coating condition.

Conduct a pipe-to-soil voltage survey of yard piping to determine on and off readings; any existing ground beds should be interrupted. Determine at this time whether all structures to be protected are bonded effectively. Isolate all structures not to be protected. Verify all nonmetallic pipe (clay, plastic, etc.).

Foreign lines, temporary lines, drain lines and blowdown lines should be checked; this is the time to decide whether to protect them or not. Some lines that are quite often found not to be tied into the main system are emergency shutdown lines, oil lines from a storage tank to a hand pump in the engine building, pump headers and spray risers at cooling towers. Occasionally there will be some equipment such as gasoline tanks or pumps near outlying storage areas that are tied into the main piping only through a power system ground wire. Pipe-to-soil voltage survey data can be recorded on the general piping plan drawing.

Read the plan as a grid. Usually all lines, or at least, the majority of them, will run parallel to the station grid system. Spot anodes in the rectangular "holes" left in the piping plan. Additional anodes should be spotted along and near semi-bare lines, concentrations of copper grounding systems, hot dry soil areas, and areas of interference due to nonconducting walls which have piping passing through. Sometimes it will be necessary to spot anodes as close as five feet to the piping.

Close Inspection Essential. Inspect each and every proposed anode location. Have the station maintenance man on hand to verify clearance from any buried piping or structures. Locate each anode position relative to some nearby above ground feature (building corner, valves, or monuments) so that the location may later be found without complicated sur-

veying. If actual construction is to begin soon, each location can be staked as it is chosen.

The cable system should be designed for a minimum amount of cable. Five to 7 anodes per cable run are the maximum practical. Thirty-five to 50 anodes are the maximum for a single rectifier. Fewer anodes per cable run make sure that the fewest anodes are lost in event of a cable failure. Cable runs originate at the rectifier, and there each run can be metered for determination of the operation of the system.

Keep Cable Runs Clear of Congested Areas. Cable runs should be located clear of all piping, driveway crossings, storage yards where heavy equipment might bog down, and future expansion areas. Check all electrical drawings carefully and note any power cables near anodes or cable runs. It is a good idea to have the station electrician check each and every case of parallel or crossing, too.

Each cable run should be located relative to some above ground feature. The route and corners should be staked for the ditching operation, if construction is to begin soon.

In most locations anode holes can be drilled to permanent moisture or low resistivity soil. Small ditching machines can put cables down to a depth of 18 to 24 inches; this has proved to be satisfactory. A wire plow can be used to lay cable runs even where soil is somewhat rocky.

Hand Dig Holes First in Power Cable Areas. For safety, before drilling in areas **suspected** of having power cables or piping, the holes should be hand dug to below probable depth of cable or pipe. Here the drilling machine operator should wear insulating gloves and stand on an insulating mat while spudding in to below the depth of power cables. Each crossing of a cable run and a piping run or power cable should be flagged and dug out by hand.

Use a junction box at each anode or small cluster of anodes. Each anode lead should be brought into the box and terminated separately. The junction box and its foundation can be set right in the ditch line for the cable runs. All cables in a ditch are brought up through each junction box they pass, although they may not terminate there. This design eliminates underground splices, saving time during construction and simplifying future maintenance.

About the Author

R. G. RANSOM, an electrical engineering graduate from Texas A. & M. College, has been engaged in cathodic protection work for Tennessee Gas Transmission Company since 1951. His present duties include system design, installation, survey work and associated instrumentation.

Ransom is a member of NACE and the AIEE.

A welding machine can be used for making a preliminary survey to determine the effectiveness of the proposed anode locations. If additional anodes are required they can be located and installed at this time. Where the anode is oversupplying protective current a resistor can be cut into an anode lead at its junction box. Then a detailed survey of the station yard can be made.

During this survey pay special attention to all high-pressure lines and other critical lines. Check any power company grounding system in or near the plant. Check any water or gas utility lines entering or leaving the plant.

From this detailed survey specific current and voltage requirements can be determined for designing rectifiers. In the design and layout of a station protection system there are too many variables and unknowns to be able to sit down and design an effective system on paper at first attempt. Often present coating conditions are difficult or impossible to predict accurately. This "cut-and-try" method has been found to be by far the fastest and most economical way of determining current requirements at TGT stations.

Size, Location, Power Needs Locate Rectifiers. Selection of rectifiers is dependent upon requirements of size, location, and available power. Usually an oil immersed unit is preferred where it is installed in the main plant area near the center of a concentration of anodes. Air cooled units can be used in outlying areas which are definitely non-hazardous.

Of course, oil-immersed types will be used regardless of location where high rectifier capacity is needed. Where the service is available three-phase rectifier operation is desirable for the larger rectifiers because of higher efficiency. However, in some instances a large single phase rectifier load may help to balance the plant power load.

After completion of the installation, a set of prints should be left in the station files for use by the station engineer or electrician in trouble shooting or planning expansion.

Station personnel can read the rectifier output weekly or more often if desirable. A switching arrangement at the rectifier will enable the station man to quickly check the individual cable runs. In this manner troubles in the system can be spotted quickly.

A detail survey should be made periodically, possibly once a year. At this time anode currents can be adjusted to compensate for changes in the coating conditions and for lines that have been added or removed. Any additional anodes required can be easily tied in to the multiple cable run and junction box system.

Future Plans Call for Protection of Every Station. All but two of TGT's compressor stations now have distributed anode ground beds installed and these two are scheduled to be put under protection in this manner in the near future. Leak frequency, although never high in this comparatively new system, has been reduced to a practical minimum. Corrosion action due to galvanic and bimetallic cells has been virtually eliminated and only those areas completely shielded from protective current are suffering any metal loss.

This distributed anode system seems to be the best solution for protecting congested plant piping built with present day construction practices and coating techniques.

—The End

Modern Ground Bed Design Saves Money

A few dollars spent initially for careful design and engineering saves many more in power costs and total investment throughout the life of the system. This up-to-date chart and nomograph will help you make accurate calculations quickly.

By JOHN E. SEARCY, JR.
Corrosion Control, Incorporated
Tulsa

ARE YOUR GROUND beds adequate today? You may be overlooking possible savings in a revision of these old ground beds or by improving methods in the design of new ones. As the use of rectifier unit impressed current systems grows, useless consumption of electrical energy in inadequate grounding systems increases, too.

In most such installations approximately 45 percent of the total power consumption is in the ground bed and approximately 40 percent in the rectifier. For a specific percent reduction in ground bed to earth resistance, approximately the same percent reduction in total power costs can be realized.

Locate Ground Beds Wisely. Optimum ground bed size can be determined by a careful consideration of these factors:

- First evaluate all possible rectifier unit locations so that the lowest possible soil resistivity may be utilized. A proper balance between the costs of investigations for lower resistivity soils and the savings realized from their utilization must be maintained.

  This includes analysis of soil conditions for reliable design data, and determination of the availability of electrical power and feasibility of installation.

- Then determine the grounding arrangement which will adequately handle the desired electrical load, operate continuously for a long trouble-free life, and result in minimum total annual costs.

Consider Power Availability. Selection of a desirable ground bed site can usually be along a section of pipe line varying from several thousand feet to perhaps ten miles or so. First consideration in the selection would be the availability of electrical power and economic limitations for extending it. A second and all important consideration is the proximity of any other structures which could intercept currents impressed from these ground beds and be seriously damaged.

Measurements of soil resistivity on and about the possible locations must be made. These measurements are usually made by the two electrode method, the four electrode fall-of-potential or mutual resistance method, or by soil box tests of earth samples. The method of testing will usually depend upon the predicted extent of the ground bed. Probably the most widely used method is the four electrode fall-of-potential method utilizing an instrument to read directly the mutual resistance between electrodes. By this method an average value of soil resistivity to various depths can be made quite rapidly.

A sufficient number of tests should be conducted to relate quite accurately the soil resistivity in and about the vicinity of the ground bed and the variation of this resistivity with depth. In unknown areas extensive tests may be required to locate the most desirable location for grounding. In other areas only a few tests might be required. Probable methods of installing the ground beds

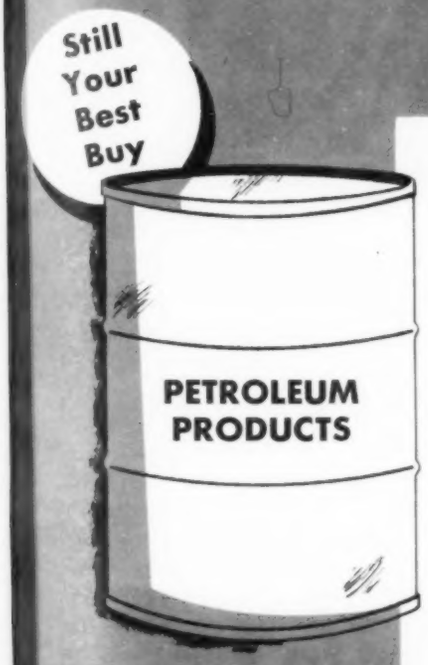
About the Author

JOHN E. SEARCY, JR., is a corrosion consultant with Corrosion Control, Inc., of Tulsa and a registered professional engineer. Searcy received his B.S. degree in engineering from the University of Virginia. He served with the U. S. Navy during World War II and has spent ten years with major pipe line and oil companies in domestic and foreign service.

A supplement to PIPE LINE INDUSTRY, March, 1957

The Facts About Oil Prices

...America's Biggest Bargain



Unfair, garbled and misleading statements followed the higher crude oil and gasoline prices posted early this year. The American public is entitled to the true facts about oil prices. After all, Mr. and Mrs. America are buyers of oil products.

While other industries have raised prices every year or oftener, there have been only two oil price advances in nine years. Oil price increases have been small compared with other commodity prices.

Mr. and Mrs. America still pay less for gasoline than for milk, soft drinks and many other items, although taxes constitute one-third of the price they pay for gasoline.

Oil is not the fabulously rich industry many believe. Oil earns a lower rate of return on capital invested than many other industries, and oil's return has declined while other returns have risen.

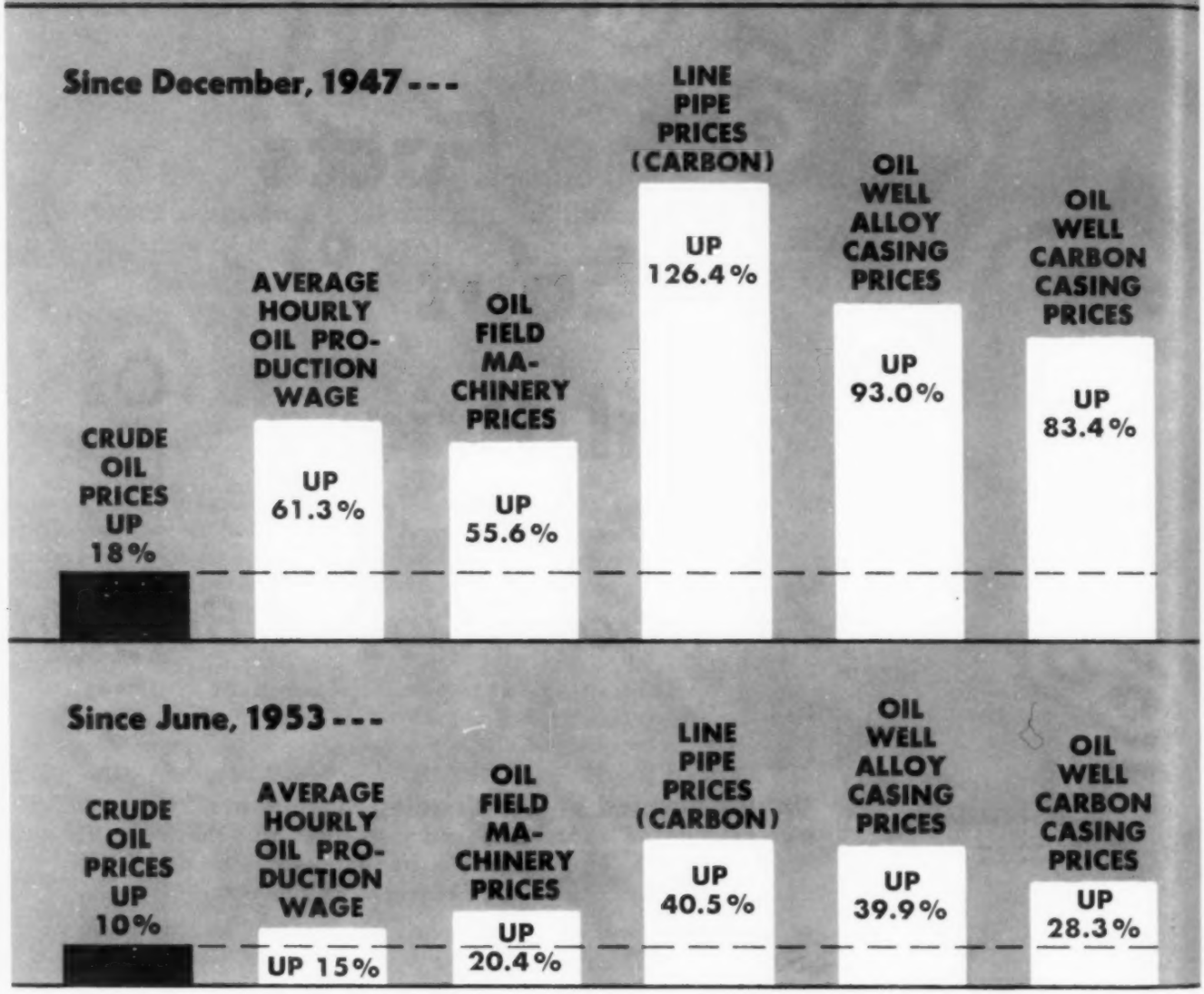
Like other businesses, oil costs have risen sharply. It is an expensive business, requiring tremendous investment. Profit rates must be adequate to attract huge investment capital. Otherwise Mr. and Mrs. America's best buy will cease to exist.

Here are the facts about oil prices . . .

Prepared for Gulf Publishing Company
Publishers of WORLD OIL, PIPE LINE INDUSTRY and PETROLEUM REFINER
By Warren L. Baker and Cecil W. Smith

COSTS OF PRODUCING MATERIALS AND LABOR HAVE RISEN FASTER THAN CRUDE OIL PRICES

Source: Bureau of Labor statistics, with revisions for latest price increases in oil (January, 1957), casing and line pipe (February, 1957).



Crude oil prices have not kept pace with the price gains of major elements in production costs. They remain low in comparison with the costs of labor and materials used by the industry.

Since 1947, there have been only two general increases in U. S. crude oil prices. A 25-cent per barrel increase took place in June, 1953, and the other, which also averaged about 25 cents a barrel, in January, 1957.

Neither of these was adequate to cover increases in the cost of finding, developing and producing crude oil. Crude oil prices today are only 18 percent above 1947, whereas prices of major elements in production costs have risen three to six times faster. The 10 percent increase in crude prices during January, 1957, did not cover all the increases in prices that have taken place since 1953.

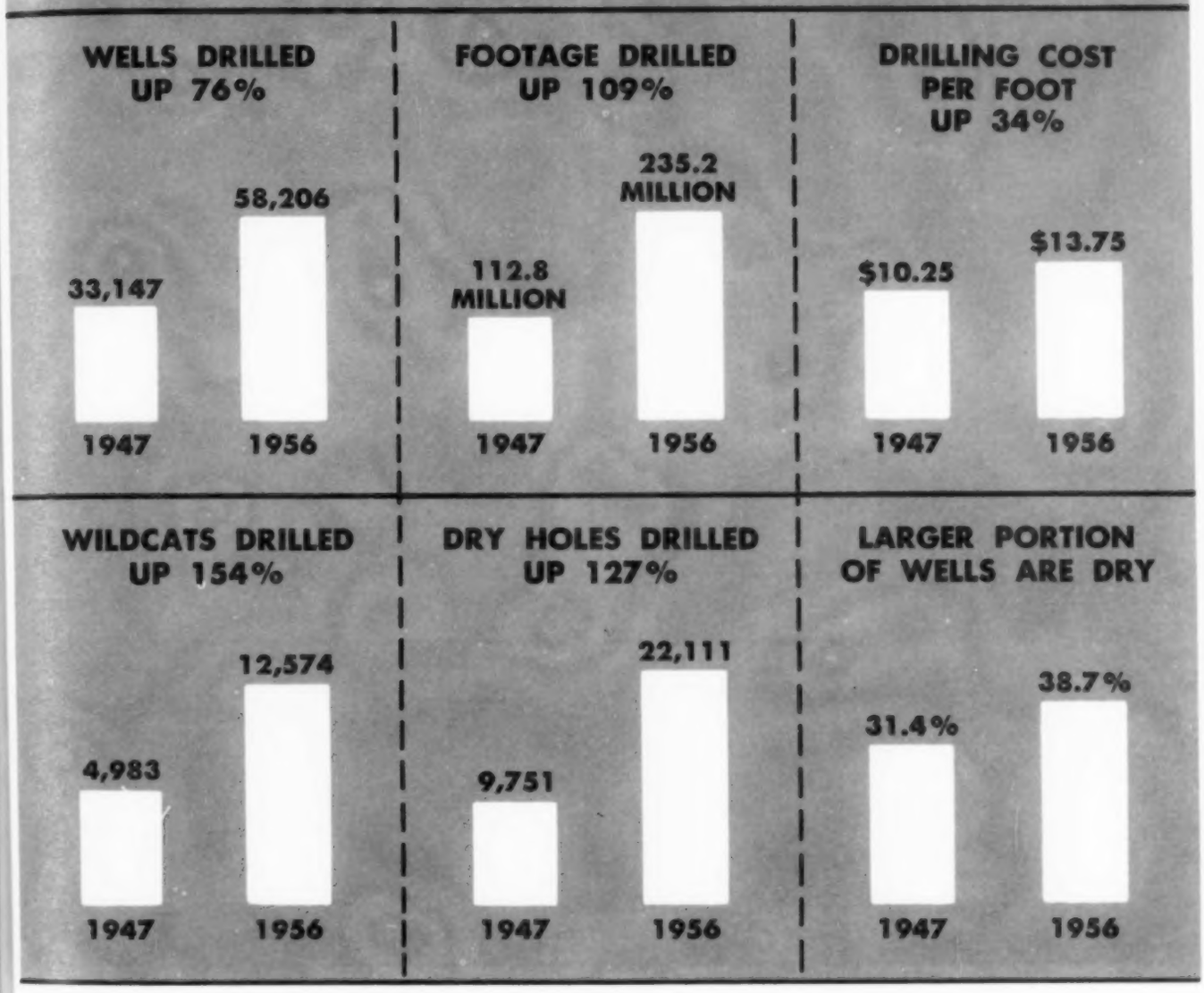
For example, the 18 percent increase in crude oil prices since 1947 compare with an increase of 61 percent in average hourly wages paid by the industry, while oil well casing has risen from 83 to 93 percent, line pipe by 126 percent, and oil field machinery by 55 percent.

Wages and steel are the two principal cost items to the oil industry. The industry uses large quantities of steel, metal and machinery, particularly in the production end of the business. It requires an average of 80 tons of steel for each new well drilled. In contrast, the average automobile requires less than two tons of steel. Yet motor vehicle prices are up 46 percent since 1947 in contrast with a gain of 18 percent for crude oil.

If this vital industry is to keep America supplied with increasing quantities of oil, it must be permitted to remain in a strong, healthy position—the price received for its product must reflect increased production costs.

FACTORS BESIDES MATERIALS AND LABOR HAVE ADDED TO OIL'S COSTS SINCE 1947

Source: Drilling cost per foot from American Association of Oilwell Drilling Contractors. Other data from WORLD OIL, February 15, 1957, Forecast-Review Issue.



In addition to higher materials and labor costs, other factors also have added greatly to the cost of finding and producing oil in the U. S.

The search for oil is big business, calling for the drilling of many wells annually to locate and develop sufficient new producing fields to satisfy the rapidly expanding use of petroleum.

To provide enough oil to satisfy Mr. and Mrs. America's 62 percent increase in demand for petroleum products since 1947, the industry has had to greatly accelerate its expenditures for drilling operations. Between 1947 and 1956 the number of wells drilled annually increased by 76 percent. Due to greater depths of wells, footage advanced even more rapidly, rising 109 percent. Footage is a truer index of expenses, costs rising sharply with depth.

To find enough oil to satisfy rising demand, the industry has nearly tripled the number of "wildcat" tests. These are wells drilled in unproven areas seeking to discover new producing fields. Wildcats constituted 22 percent of all wells drilled in 1956, in contrast with only 16 percent in 1947.

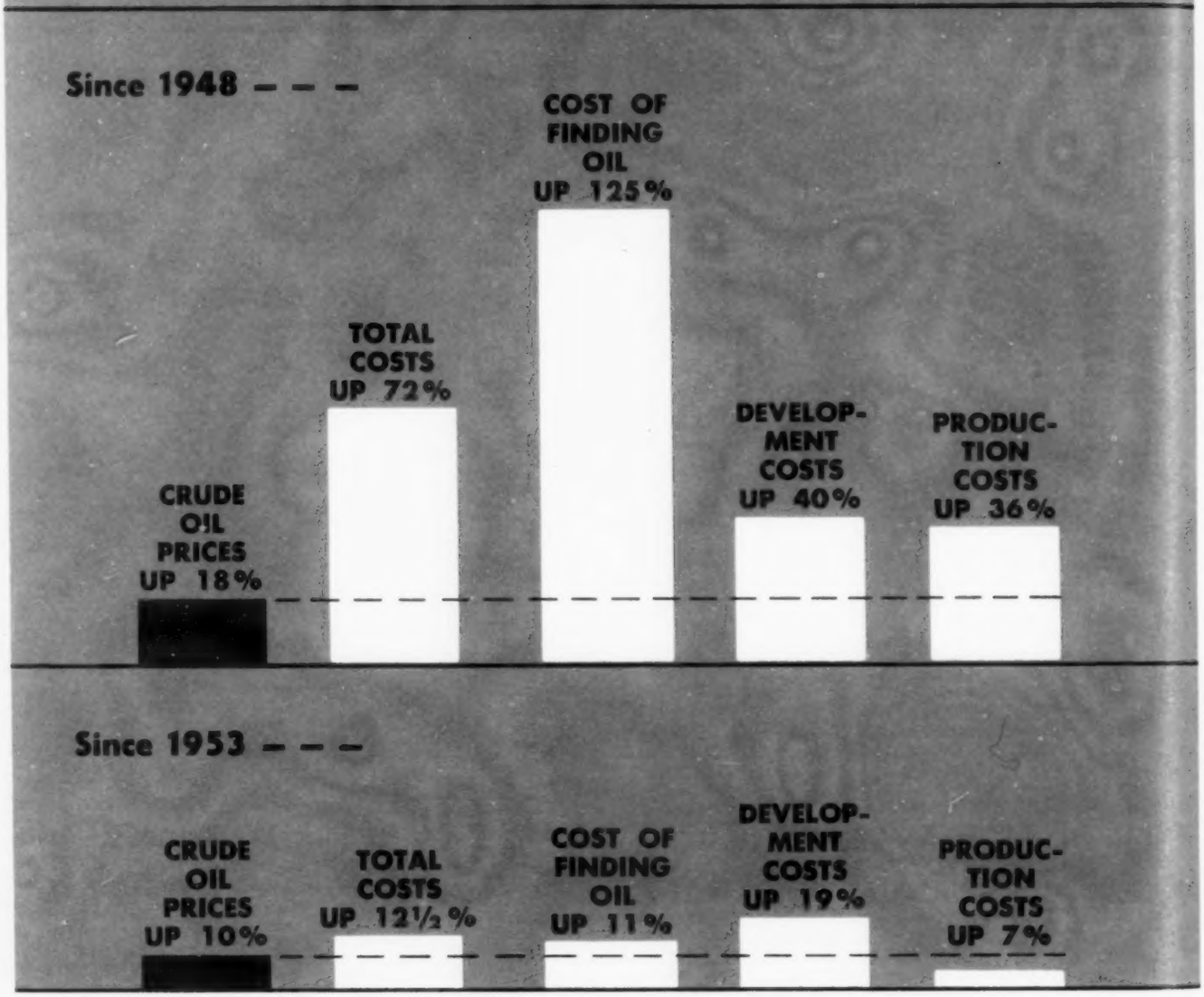
Terrific financial odds are involved in the drilling of wildcats. Here is where many an oil man loses his pants as well as his shirt. Eighty-eight percent of all wildcats drilled invariably fail to find production—only 1 out of 9 ever produce any oil or gas. They are complete financial failures.

Increased wildcatting resulted in the drilling of 2¼ times more dry holes during 1956 than in 1947. This resulted in 38.7 percent of all wells drilled (wildcat and field development wells) being dry holes during 1956, whereas less than 30 percent were dry prior to 1946.

All these factors have tended to add greatly to the cost of finding and producing oil in the U. S.

RECENT PRICE INCREASE IS NOT EQUAL TO GROWTH IN OVER-ALL OIL PRODUCING COSTS

Source: M. J Rathbone testimony before House Interstate Commerce Committee


Since 1948 – – –
CRUDE OIL PRICES UP 18%
TOTAL COSTS UP 72%
COST OF FINDING OIL UP 125%
DEVELOP-MENT COSTS UP 40%
PRODUC-TION COSTS UP 36%
Since 1953 – – –
CRUDE OIL PRICES UP 10%
TOTAL COSTS UP 12½%
COST OF FINDING OIL UP 11%
DEVELOP-MENT COSTS UP 19%
PRODUC-TION COSTS UP 7%

Oil production costs have risen more than crude oil prices since World War II. Even after the January, 1957, increase crude oil prices did not equal the growth that has occurred in costs. Higher costs indicate oil price increases were long overdue.

Because of the many factors discussed on the preceding two pages, total production costs advanced 72 percent between 1948 and 1956, and by 12½ percent between 1953 and 1956. Even with the January, 1957, increase, crude oil prices were only 18 percent above 1948, and but 10 percent higher than in 1953. These are 1957 oil prices compared with 1956 oil costs.

Further increases in production costs will occur in 1957. Early February price advances for oil well casing and line pipe may add as much as $40 million to the industry's operating costs in 1957.

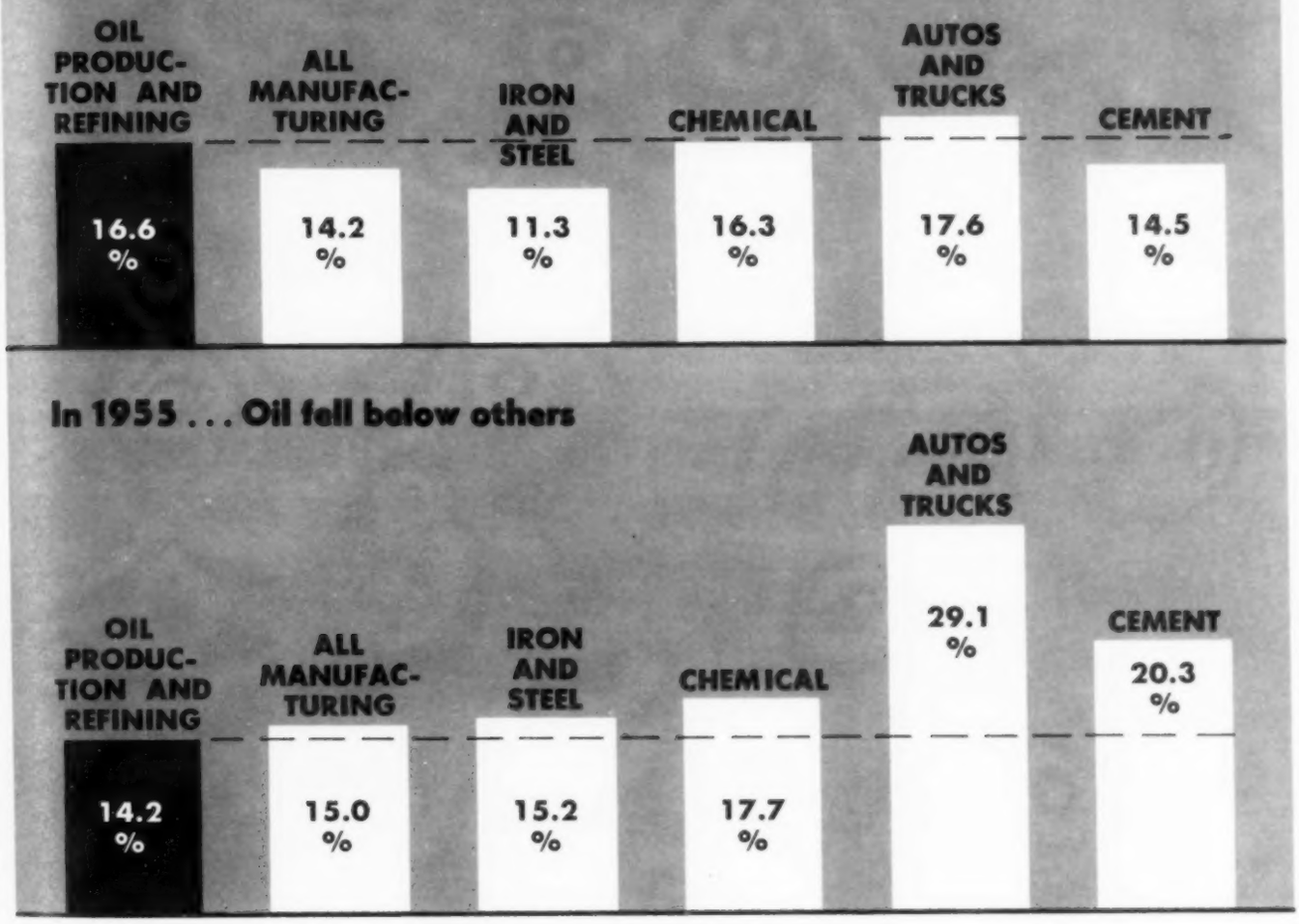
A particularly large increase in the cost of finding oil occurred between 1948 and 1956. A growth of 125 percent was recorded. This big gain was due to the increased number of wildcats drilled and the growing number of dry holes drilled, as well as higher wages and prices of casing and machinery.

Finding new producing fields is the industry's big risk—the operation that makes it different from any other business. Prices must be adequate to provide ample incentive, or men will not risk huge sums at 1-out-of-9 odds.

Unless wildcatting is maintained at high rates, the nation's oil producing ability would soon shrink below needs. The output of oil wells inevitably declines gradually as they become older. America's high consuming rate requires the discovery of over 4 billion barrels of new oil each year.

RATE OF RETURN ON CAPITAL INVESTMENT HIGHER IN OTHER INDUSTRIES THAN IN OIL

Source: First City National Bank of New York Monthly Letter.
Data based on leading corporations in each industry.



Oil is not the fabulously profitable business so many consider it to be. Many other businesses earn a higher rate of return on capital investment.

Furthermore, failure of oil prices to keep pace with rising costs has meant decreasing profit margins in recent years while returns of other industries have increased. The rate of return on investment by leading oil companies has never been out of line with that of other business and in recent years has been quite moderate in comparison with other industries.

In net return on net assets the oil industry is behind such businesses as iron and steel, chemical products, motor vehicles, all manufacturing industries and others.

Ninety-two leading U. S. petroleum producing and refining corporations, including those with large foreign holdings as well as domestic, had a return of 14.2 percent on their net assets in 1955, latest year available. This compared with a 16.6 percent in 1951.

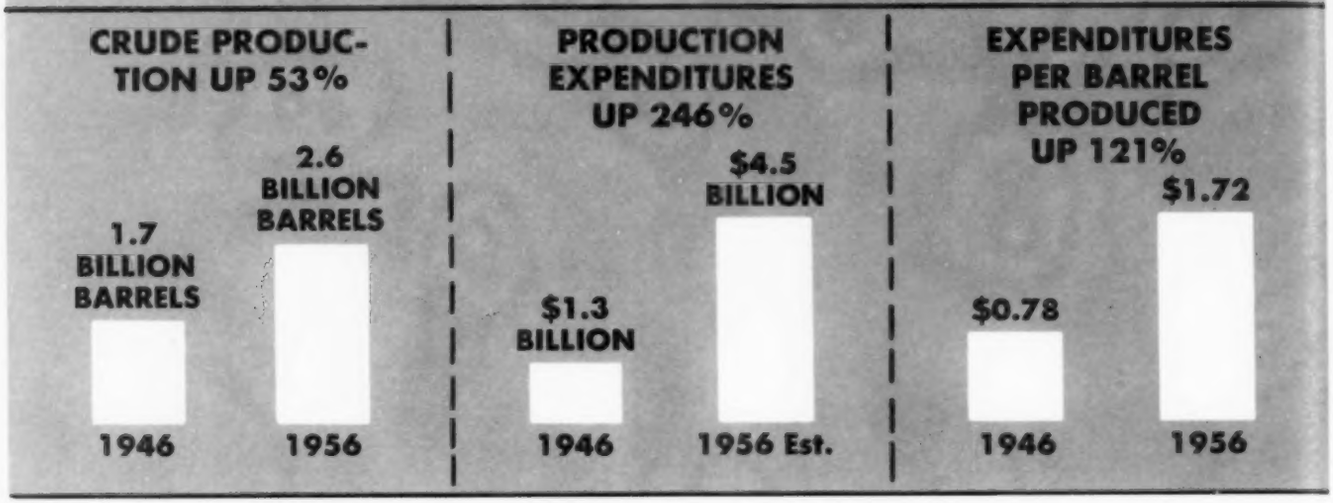
Rising costs without corresponding increases in prices have cut down net returns on oil investment. Because of greater risks in oil producing operations, the oil industry should enjoy higher rates of return than other businesses.

In contrast, manufacturing, iron and steel, chemicals, autos and trucks, cement and other industries had higher return rates on their investments in 1955 than in 1951. Some were up by substantial amounts. The automobile industry, for example, had a net return of 29.1 percent in 1955 compared with 17.6 percent in 1951.

Mr. and Mrs. America hear of the few oil men who are fortunate enough to hit a bonanza. But they never hear of the thousands of oil men who struggle throughout their lives to make ends meet, nor of those who lose vast sums of money hoping to find an oil field.

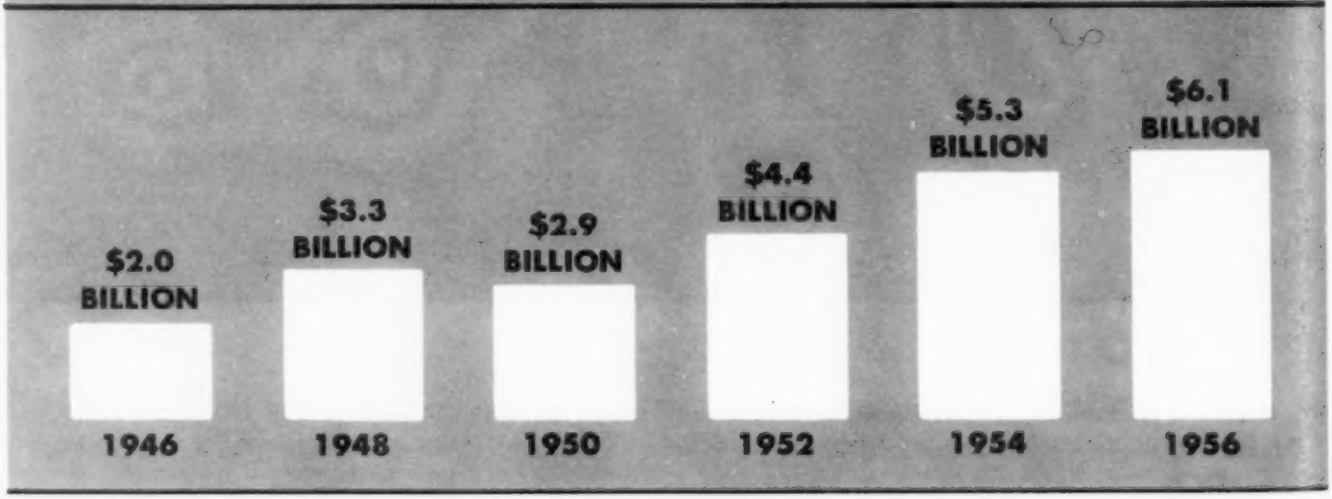
BIG GROWTH IN CAPITAL EXPENDITURES FOR U. S. OIL PRODUCTION FACILITIES

Source: Production from Bureau of Mines. Expenditures (for property, plant and equipment only) from Chase Manhattan Bank.



TOTAL ANNUAL CAPITAL EXPENDITURES OF OIL INDUSTRY HAVE TRIPLED SINCE 1946

Source: Chase Manhattan Bank "Investment Patterns in World Petroleum Industry". Expenditures cover property, plant and equipment.



Oil is an extremely expensive business. Huge capital investment is required to provide enough oil to meet expanding U. S. civilian and industrial requirements.

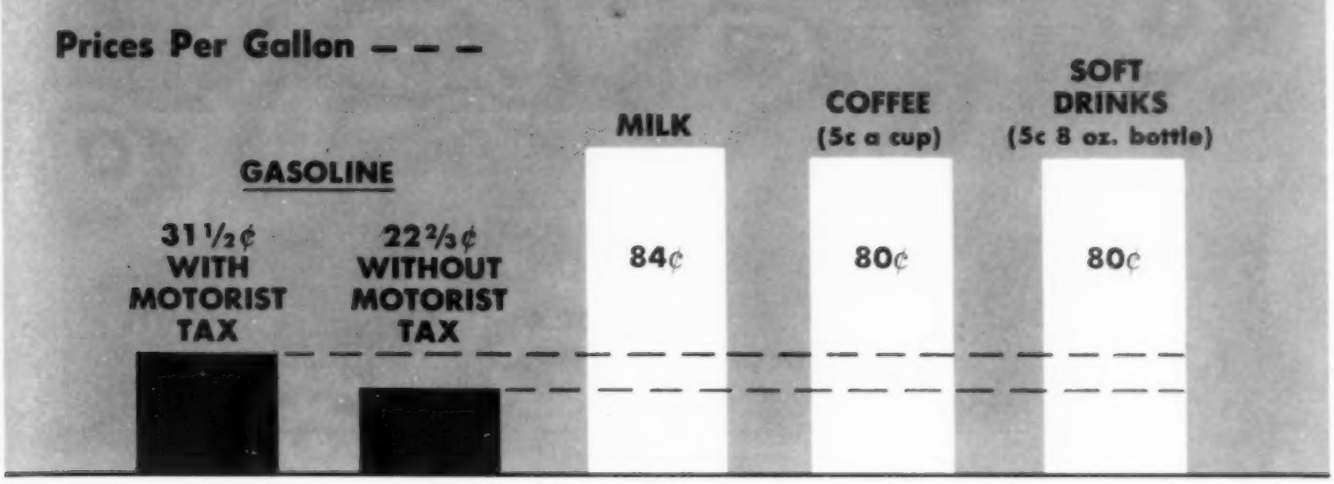
Total annual petroleum capital expenditures in the U. S. (for property, plant and equipment only) have risen sharply in recent years. They reached the staggering sum of $6.1 billion during 1956, three times larger than in 1946. Most of this investment was in producing operations.

Since World War II capital investment in U. S. oil has totaled $44.2 billion. No other industry has matched this investment rate. Oil now ranks as one of the largest industrial activities in the nation.

It is highly important that oil have an adequate profit level. Chase Manhattan Bank has estimated $51 billion will need to be invested during the next ten years to keep America supplied with oil. There would be no hope that a sum of such magnitude could be generated internally or be attracted from outside investors unless the industry's prices keep pace with rising costs.

The recent Suez crisis has demonstrated dramatically that adequate domestic oil supplies are vital to America's security. America must have oil. It operates on oil.

AMERICANS STILL PAY LESS FOR GASOLINE THAN FOR MANY OTHER COMMODITIES



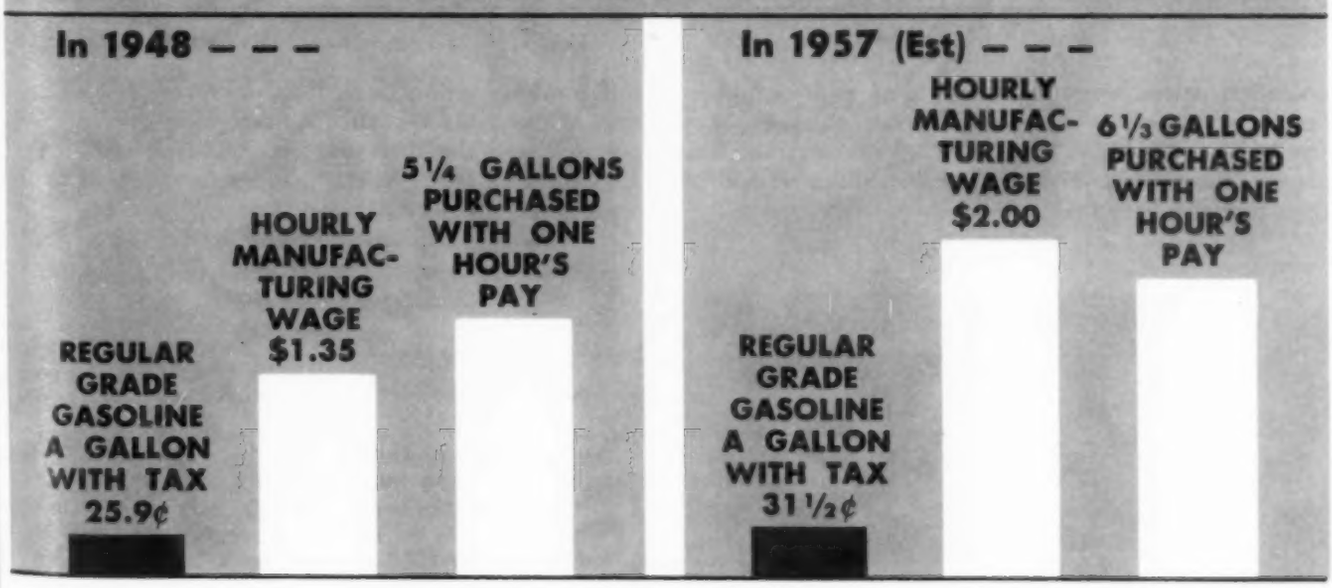
Gasoline Is Still Cheap. It is still America's biggest bargain. Such items as milk, coffee and soft drinks retail for about 2½ times more than gasoline. This is true today, even after the recent gasoline price advance.

Mr. and Mrs. America pay an average of 31½ cents a gallon for regular grade gasoline today. However, state and federal motorist taxes make up nearly 9 cents of this amount. But even with taxes included, gasoline is cheap, costing only 2 cents per mile traveled.

Gasoline weighs approximately 6 pounds a gallon, hence sells for 5⅓ cents per pound including taxes. What else sells for so little these days?

GASOLINE STILL BETTER BUY THAN IN PAST

Source: Gasoline Prices from American Petroleum Institute. Hourly wages in Manufacturing from Bureau of Labor statistics.


In 1948 — — —
REGULAR GRADE GASOLINE A GALLON WITH TAX 25.9¢
HOURLY MANUFAC-TURING WAGE $1.35
5¼ GALLONS PURCHASED WITH ONE HOUR'S PAY
In 1957 (Est) — — —
REGULAR GRADE GASOLINE A GALLON WITH TAX 31½¢
HOURLY MANUFAC-TURING WAGE $2.00
6⅓ GALLONS PURCHASED WITH ONE HOUR'S PAY

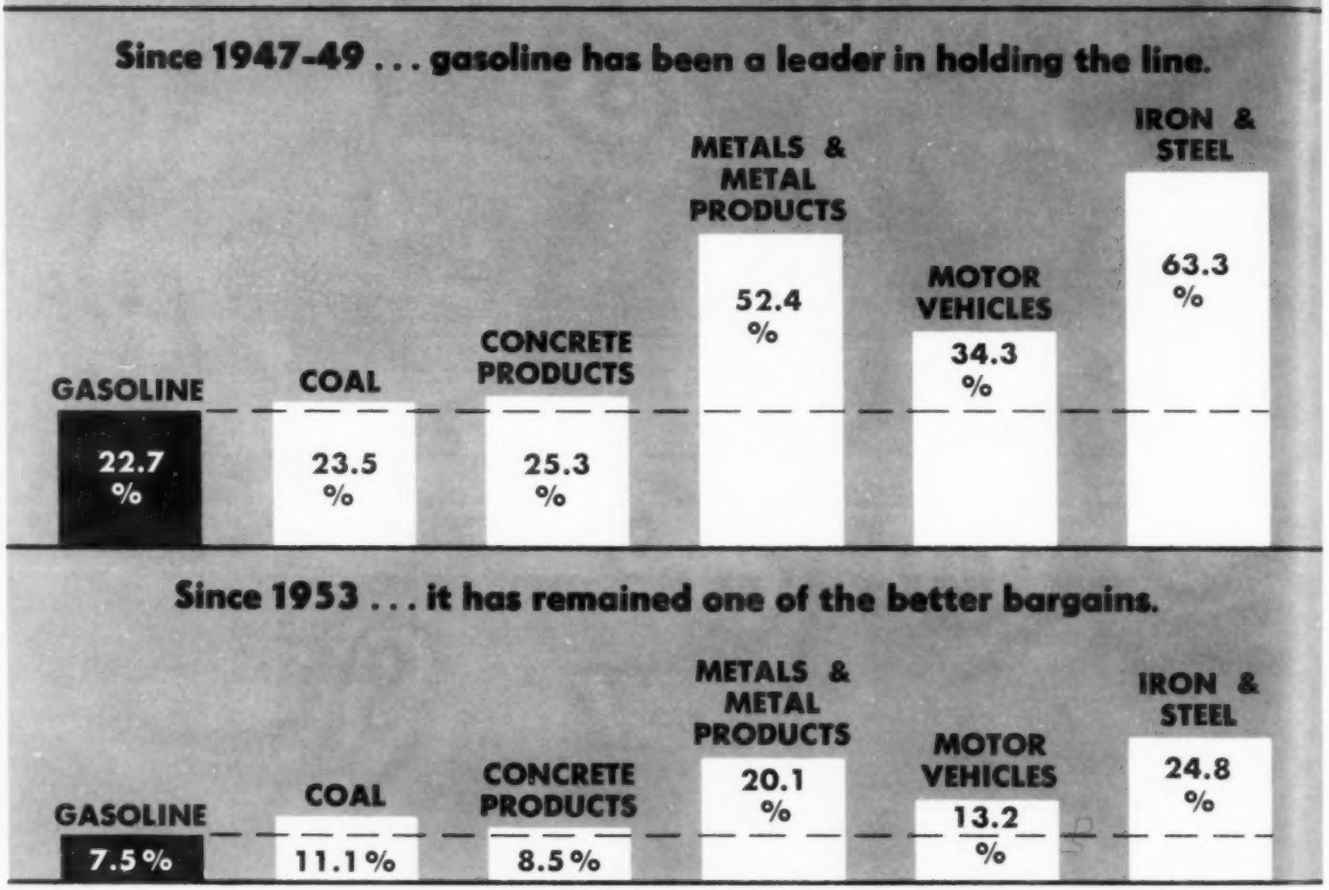
Gasoline takes a smaller portion of U. S. workers' pay today than in the past. More gasoline can be bought today with an hour's pay. Furthermore, the quality of gasoline is far superior to earlier years.

The average hourly wage of manufacturing employes, for example, will buy 6⅓ gallons of gasoline in 1957. Their hourly pay in 1948 would purchase only 5¼ gallons. These costs include all state and federal taxes.

If it were not for high motorist taxes, manufacturing employes could buy nearly 9 gallons of gasoline in 1957 with each hour's pay in contrast with slightly less than 7 gallons in 1948.

WHOLESALE PRICES SHOW GASOLINE ADVANCED LESS THAN THESE COMMODITIES

Source: Wholesale gasoline prices from American Petroleum Institute.
Other prices from Bureau of Labor (December, 1956).

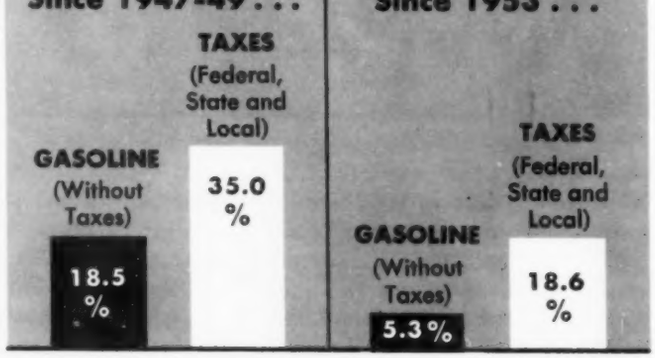


Gasoline prices have risen less than most commodities. After the recent increase, wholesale gasoline prices are 22.7 percent above the 1947-1949 average, and 7½ percent above 1953. Few other commodities outside of farm products have had so small an increase.

Taxes have grown faster than the retail price of gasoline. Without taxes, retail gasoline prices are only 18.5 percent above the 1947-1949 average, while taxes are up 35.0 percent. Nevertheless, gasoline is still one of the biggest bargains in America today.

GASOLINE TAXES INCREASED AT FASTER RATE THAN PRICES

Source: American Petroleum Institute



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must be kept in mind. Apparently adequate locations can often prove extremely difficult and too expensive for installation.

With adequate data from field observations the choice of a most feasible grounding arrangement can then be made. Most widely used configurations are a horizontal anode in straight line or a series of vertical anodes in straight line. Absolute straightness of the line in either case will depend upon the physical conditions and soil resistivity indicated by the field observations. When considerable deviation from straight line configuration such as parallel lines, "L" shape, etc., are necessary, there will be more mutual resistance between anodes than when in straight line.

Chart Speeds Resistance and Power Cost Calculations. For conventional type ground beds the chart shown in Figure 1 permits a rapid determination of the resistance to earth of various ground beds and the yearly power costs based on 50 percent efficient rectification. These particular curves have been specifically designed for the standard 3-inch x 60-inch and 4-inch x 80-inch graphitic carbon anodes centered in a vertical or horizontal excavation and backfilled to the dimensions indicated with very well tamped coal coke breeze.

Location of the graphitic carbon rod in the coke breeze may be altered to take advantage of some particular soil resistivity characteristic and thereby lower somewhat the ground bed resistance indicated by the chart.

Here's How the Chart Works. To explain use of this chart, let's assume data for designing a rectifier-ground bed installation. Soil resistivity over the entire area for locating a grounding arrangement is 1000 ohm-cms. and consistent with depth. Power is available from the Power Utility Company at 3 cents per KWH. After previous studies of line characteristics, etc., the utilization of a 20-ampere capacity unit is decided to be a most economical and feasible unit for the 15-year operation.

To determine the optimum size ground bed, enter the chart in Figure 1 at the "Soil Resistivity-ohms-cms."

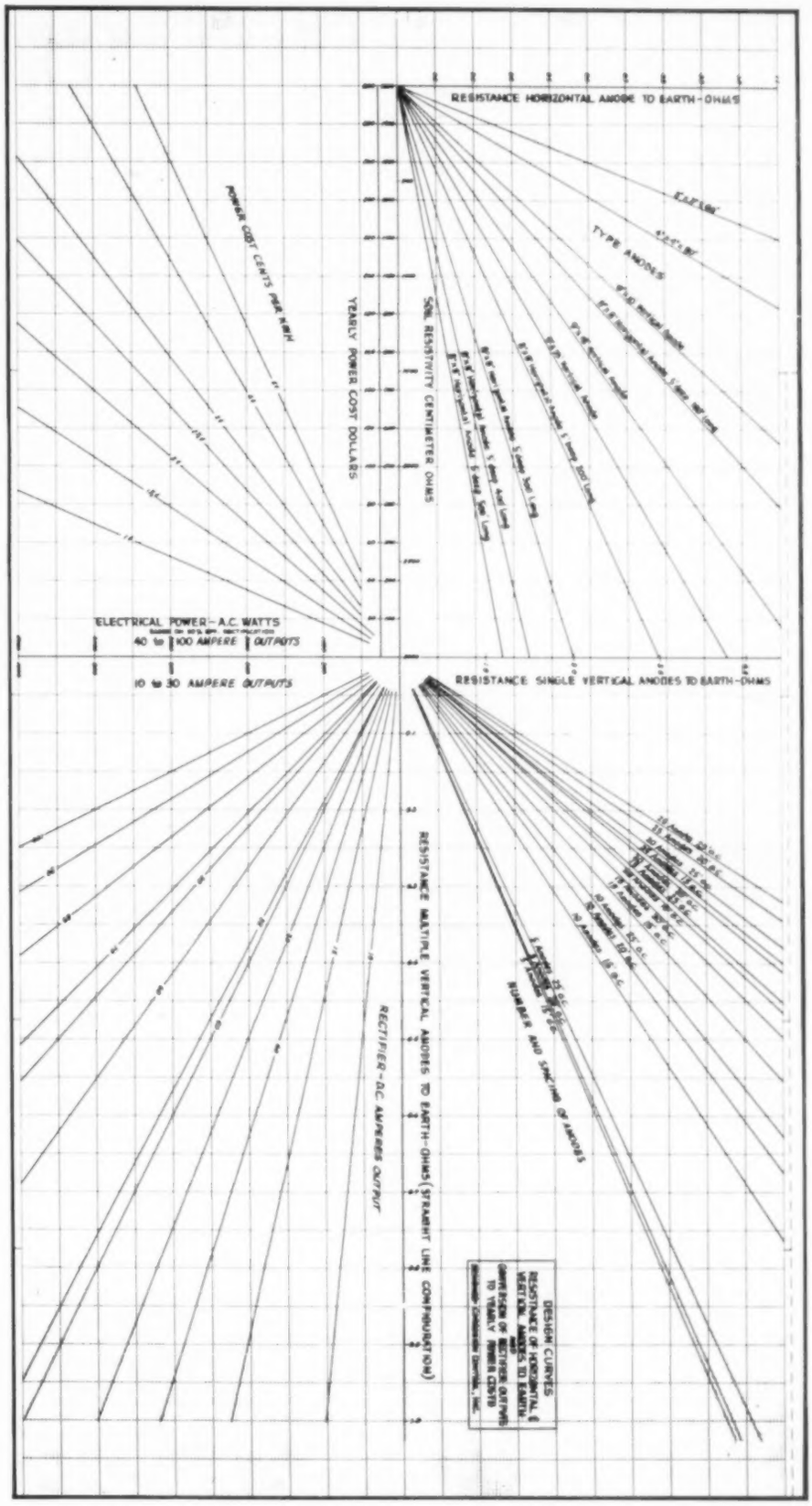
RESISTANCE HORIZONTAL ANODE TO EARTH-OHMS
POWER COST CENTS PER KWH
YEARLY POWER COST DOLLARS
SOIL RESISTIVITY CENTIMETER OHMS
ELECTRICAL POWER—A.C. WATTS
40 to 100 AMPERE OUTPUTS
10 to 30 AMPERE OUTPUTS
RESISTANCE SINGLE VERTICAL ANODES TO EARTH-OHMS
RESISTANCE MULTIPLE VERTICAL ANODES TO EARTH-OHMS (STRAIGHT LINE CONFIGURATION)
RECTIFIER-D.C. AMPERES OUTPUT
RUBBER AND SPACING OF ANODES
DESIGN CURVES
RESISTANCE OF HORIZONTAL &
VERTICAL ANODES TO EARTH
OPERATION OF RECTIFIER (BETWEEN
TO YEARLY POWER COSTS

FIGURE 1—This chart permits quick determination of resistance to earth and annual power costs for many ground bed configurations. Power costs are based upon a 50 percent rectification efficiency.

DATA SHEET FOR THE ECONOMIC STUDY OF GROUND BEDS

TYPE GROUND BED	1 Unit Cost Per Anode	2 Total Invest. Cost	3 Annual Power Costs	4 Annual Invest. Cost & Annual Power Cost From Nomograph	5 Annual Operating & Maint. Costs	6 Taxes & Other Annual Costs	7 Total Annual Costs 4+5+6	REMARKS
25 ANODES — 25' o.c 20' deep 2' cover								
10' deep 2' cover								
25 — 20' 20' deep 2' cover								
10' deep 2' cover								
25 — 15' 20' deep 2' cover								
10' deep 2' cover								
20 — 25' 20' deep 2' cover								
10' deep 2' cover								
20 — 20' 20' deep 2' cover								
10' deep 2' cover								
20 — 15' 20' deep 2' cover								
10' deep 2' cover								
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10' deep 2' cover								
10 — 15' 20' deep 2' cover								
10' deep 2' cover								
5 — 25' 20' deep 2' cover								
10' deep 2' cover								
5 — 20' 20' deep 2' cover								
10' deep 2' cover								
5 — 15' 20' deep 2' cover								
8" x 8" ANODE 5' deep 100' long								
8" x 8" 5' 200'								
8" x 8" 5' 300'								
8" x 8" 5' 400'								
8" x 8" 5' 500'								

FIGURE 2—Printed data sheets such as this one are helpful in comparing the economics of ground bed selection.

line and extend a vertical line from the 1000 ohm-cms. point to intersect all the anode types. (Extrapolation of these curves may be necessary in higher resistivity soils.)

Then proceed horizontally to the left for the resistance to earth of horizontal type anodes and horizontally to the right for vertical type anodes. Various groups of vertical anodes with 15, 20, and 25-foot spacings are represented by curves in the upper right hand section. These are plotted such that the abscissa of this section reflects the apparent resistance to earth of these configurations, including mutual resistance between anodes.

Resistance values for horizontal anodes obtained from the ordinate of the upper left hand section should be transferred to the abscissa of the upper right hand section to determine power consumption and annual costs from the lower right hand and lower left hand section. In obtaining power costs for the two lower sections, the ordinate shows power consumption in AC watts based on 50 percent efficient rectification, and the abscissa of points on the lower left hand section indicates annual power costs in dollars. This series of graphs can thus be used to determine the most economical grounding arrangement.

Solve a Sample Problem Quickly! To illustrate, consider the case of a 30 ampere rectifier unit in 1200 ohm cm soil at all depths. Using a 3-cent per KWH electrical power and installation costs common for the Mid-Continent area, it can be readily deducted that a ground bed of approximately 20—9-inch x 18 feet anodes, twenty feet on centers will result in minimum total annual costs.

Check Soil Resistivity Carefully. Usually consideration must be made of the soil resistivity data prior to determining from these curves the resistance of a specific type ground bed. Should the field data indicate apparent soil resistivity of 1000 ohm cms to a 5-foot depth, 1200 ohm cms to a 10-foot depth, and 5000 ohm cms to a 20-foot depth, one might conclude that it would be desirable to utilize an arrangement of 10-foot vertical anodes or a horizontal type anode.

To determine the resistance to earth of these arrangements, it would be logical to enter the chart at approximately the 1100 ohm cm point. The indicated resistance to earth would then be considerably lower than the actual value. Here the

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choice of ground beds might require an adjustment in the computed ground bed resistance due to the higher resistivity lower earth.

If, however, the 20-foot reading had been 500 ohm cms, for the same ground beds the indicated resistance to earth would be somewhat higher than the actual value. In this case, anodes driven into this lower resistivity layer of earth probably would be more desirable. In many cases the soil resistivity to depths considerably in excess of 20 feet will greatly affect the calculated resistance to earth of an extensive ground where only immediately adjacent soil is considered.

New Type Beds May Be Answer. It may be worthwhile to consider other than these conventional type ground beds. Present experiments with several new concepts promise improvements over conventional types. Even so, design for today's arrangement of proven materials and methods must aim for minimum annual costs.

Data Sheet Aids Comparison. Almost all of the specific conventional ground bed types are listed on the data sheet in Figure 2. Columns list unit cost per anode; total ground bed cost or total investment cost; annual power costs which can be computed from Figure 1; total investment costs and power cost for the designed life as equal annual costs which can be computed from the nomograph in Figure 3 if the designed life and interest factor correspond with those for which the nomograph was made; annual operating and maintenance costs; annual taxes and other costs, and total annual costs.

Many Factors Affect Location. Other items to consider in ground bed design are back voltage encountered in graphic carbon grounding materials; gassing, which may be of minor importance especially when anode current densities are relatively small; chemical treatment of earth to lower its resistivity; and location of the ground bed relative to the pipe line.

Probably the most important of these would be the location of the ground bed relative to the line. This will depend to some extent on the resistance to earth of the pipe line.

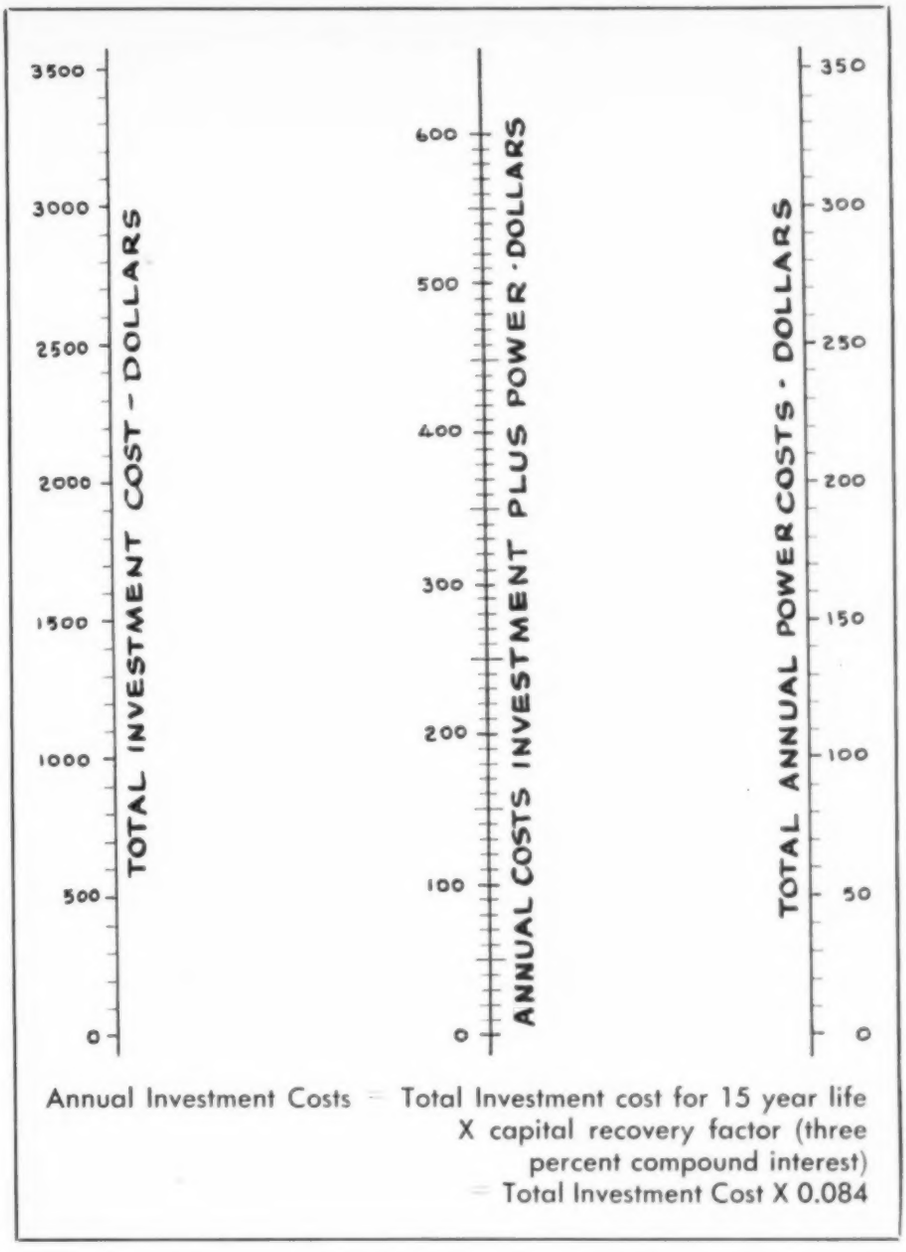

FIGURE 3—Nomograph shows quickly what the total annual ground bed costs will be, knowing annual power costs and original investment. Total investment cost assumes a 15-year life and 3 percent interest in capital recovery factor.

On a bare or poorly coated line it may be desirable to install the ground bed 250 feet or more from the line. On a well coated line, except for abnormally high potential gradients about the pipe line in the vicinity of the ground bed, there would be no other apparent reason for installing the ground bed very far from the line.

Right of way difficulties often arise and the ground bed is relocated in what is most probably a less desirable location from the standpoint of physical conditions and soil resistivity.

These general ideas are directed primarily to ground beds utilized in pipe line rectifier units, but they may well apply to many other impressed current installations utilizing rectifier ground bed systems. As more and more of this type installation are used, the need for more efficient utilization of electrical power will also become more important.

A few dollars saved today by installing an inadequate ground bed will be spent several times over in electrical power bills during the following years of operation. When considering new units, make a reasonable investigation of field conditions. Apply to these field conditions sound engineering and economic principles, and divert the savings which will be realized to useful corrosion control systems elsewhere. —The End

What Makes A Good Pipe Line Coating?

Tests and field experience show what a coating will do; specifications serve as a safeguard to insure that you will receive the kind of protection you order.

By W. F. FAIR, JR.
Koppers Company, Incorporated
Verona, Penn.

FIGURE 1—Careful laboratory testing of coating materials provides a basis for predicting service performance. Here a coated panel is removed from a water immersion tank and the surface is dried as the first step in evaluating coating properties.

DURING THE MANY years that pipe line enamels have been manufactured, sold, and applied to thousands of miles of underground pipe lines, there have been no universally accepted official specifications covering all such products. Specifications sponsored and published by the American Water Works Association constitute the only exception to this statement. The AWWA Specifications[1] restrict the lining and coating material to coal tar enamels, and give specifications covering certain important physical properties and methods of laboratory testing for these hot applied coatings.

Absence of specifications for non-water works enamels certainly has not been due to lack of interest in this field. All manufacturers and distributors of coal tar enamels have issued, published and distributed their own product specifications. These have been accepted by consumers all over the U. S., more recently in Canada and in Mexico, and frequently for installations in many foreign countries. Recently there has been increasing interest in this general field of specifications for pipe line coatings because of the growing appreciation of the importance of industrial safety codes.

NACE To Set Minimum Requirements. Request for assistance in connection with corrosion items in drafting safety codes was made in 1954 to the National Association of Corrosion Engineers. The preparation of "Minimum Requirements for the Protection of Buried Pipe Lines" was assigned to NACE Technical Committee T-2 on pipe line corrosion. Various subcommittees have been working on different parts of this major problem. The subcommittee assigned to consider and advise on coal tar coat-

ngs has submitted a report on tentative recommendations for material selection and practices to be adopted in the underground use of coal tar coatings. This report includes coating requirements, long term performance considerations, primers, enamel properties, and application of coal tar coatings to pipe.[2]

The essential point to keep in mind in reviewing this field is that the specifications written by AWWA and the additional recommendations recently offered for information and comment are derived as the result of years of service. Properties and range of values selected were not determined by speculation or preliminary laboratory testing, but are based upon observed values for materials known to have given years of satisfactory service under various kinds of application conditions and underground corrosion environments.

Most specifications for other kinds of bituminous materials have been similarly derived. The many methods of test and specifications adopted and published by the American Society for Testing Materials were nearly all produced in this manner. Laboratory testing and examination gave the numbers to be assigned to various properties of materials such as steep roof asphalt, coal tar flat roofing pitches, roofing felts, road tars, asphaltic road oils, and the like, after these products had performed satisfactorily in their respective fields of service. It must be emphasized that the current specifications on these materials apply only to the particular type under consideration and cannot safely be used to procure any other material no matter how superficially similar. For instance, the ASTM and the American Association of State Highway Officials' specifications are both quite different for road asphalts and road tars, respectively; and they cannot be used interchangeably, regardless of the road binder available, without possibility of early failure.

Specification Tests. In reviewing coal tar enamel specifications, items usually encountered include percent ash, specific gravity, softening point, flow temperature, penetrations at 77° F. and at 115° F., and low temperature crack test.

Determining Ash Content. Inert fillers are incorporated in coating materials to provide resistance to flow

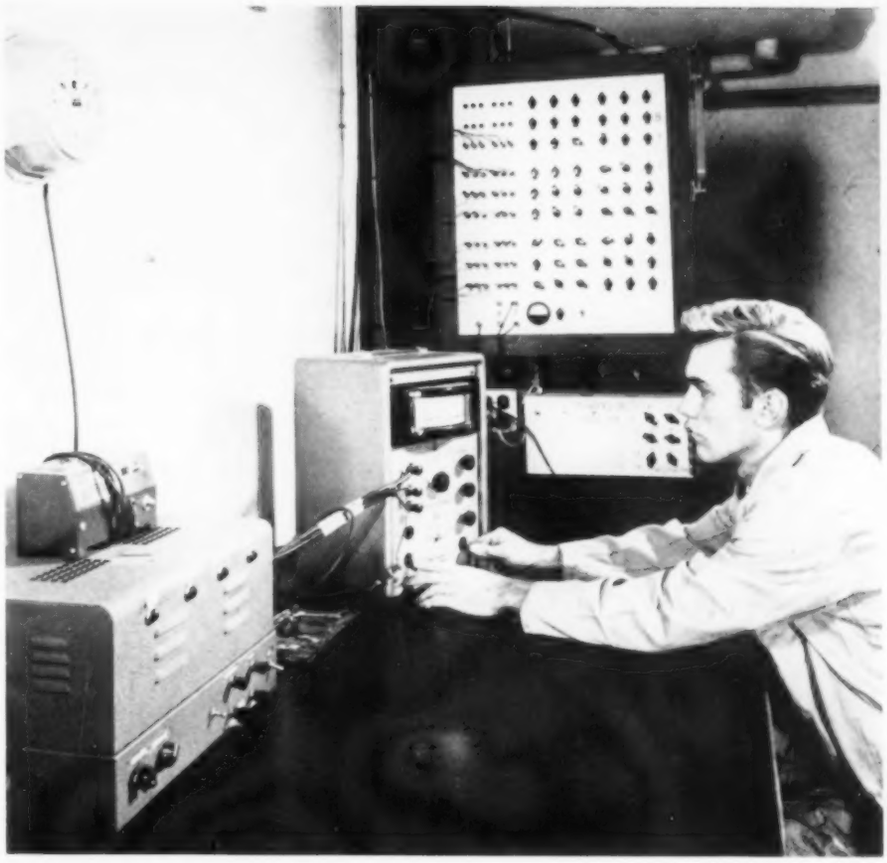

FIGURE 2—Instrumentation set-up used to measure the volume resistivity of panels coated with pipe line enamel. Panels are immersed in a water test tank such as that shown in Figure 1.

under service conditions and to provide resistance to chemical degradation. The filler used should be low in moisture and carbonates—which can be easily checked upon procurement—and should have negligible water absorption characteristics; it should be of a proper size and gradation to meet the manufacturers' and consumers' requirements.

Amount of filler usually is of the order of 18-35 percent, depending upon the type of enamel desired. Combustion of a small weighed sample of the enamel in a crucible at high oven temperature drives off the bituminous portion of the enamel and leaves the filler as ash. From weights taken before and after combustion, the percent of ash in the sample may be calculated.

Filler Influences Specific Gravity. Specific gravity is, of course, affected by the amount and kind of filler used. The greater the percent of filler and the higher its gravity the higher will be the specific gravity of the product obtained by weighing a measured volume of sample.

Thicknesses obtained when the enamel is applied will be determined to a great extent by the specific gravity and the viscosity of the coating at the time of application. Frequently these two opposing factors may tend to nullify their respective effects.

Usually the filled high gravity coal tar enamels become very fluid upon heating to pre-selected appropriate temperatures, whereas many other coatings of lower gravity have inherent viscosity properties which require heating to higher temperatures to obtain a condition of fluidity suitable for application at the required thickness.

Softening point and sag test requirements are related. The softening point test is run by pouring the melted sample into a cylindrical brass mold, trimming off excess material with a sharp knife and placing on the surface a small steel ball of specified shape and weight. This assembly is suspended by attachment to a thermometer in a glycerine bath according to ASTM specifications. The bath is then heated at a rate of about 5 degrees per minute until the steel ball sinks through the enamel, which be-

comes softer and softer as the temperature rises, and drops to the bottom of the beaker. The temperature at which this occurs is defined as the softening point temperature.

It is obviously an extremely crude measure of approximate viscosity. It has been suggested that for bituminous materials the viscosity is approximately 1 x 10^6 centipoises at the softening point temperature. However, a planned investigation of this approximation several years ago by an ASTM group showed that this relation between viscosity and softening point temperature was too variable to be of any value.

The sag test is conducted by coating a panel with the enamel and scribing parallel horizontal lines across the coated surface. It is then suspended in an oven at a pre-selected temperature for a specified number of hours, after which the sample is examined and the extent of slide or absence of slide at the temperature of test is measured and recorded. It has been well established that tendency to sag under these test conditions are directly dependent upon the softening point; high temperature without sagging being found for materials of higher softening point.

Use of felt wrapper or glass reinforcement or both in the field gives protection against sagging. Coated pipe may be white-washed on the exterior, or coated with cold applied coal tar pitch emulsion, to prevent excessive temperature increase and possible sag if exposed to sunlight for lengthy periods before burial.

Penetration values are determined by letting a cylindrical needle having a truncated cone drop through a sample under a specified weight for a specified number of seconds, after a cup of the material has been brought to the pre-selected test temperature. Usually, penetrations are run according to ASTM specifications using a 100-gram weight for 5 seconds at 77° F. and a 50-gram weight for 5 seconds at 115° F. Occasionally penetrations are run at 32° F., using a 200-gram weight for one minute, for special plasticized type coatings.

Penetration tests really amount to an undefined indication of the hardness or softness of the material. The material whether of moderate or high softening point may exhibit complete lack of penetration or a very small degree of penetration. Conversely, some coatings can be intentionally made to have both a high softening point and a considerable amount of penetration by the needle under the specified test conditions.

It cannot be emphasized too much that there is no established theoretical or empirical relation between viscosity and penetration.

Early research suggested that there might be a valid relation between viscosity and needle penetration for materials that demonstrably exhibit Newtonian flow; that is, constant viscosity independent of rate of shear. A study of relatively low melting coal tar flat roof pitches proved conclusively that these materials had no yield values, were definitely Newtonian in rheological characteristics, were unquestionably self-healing, and did not follow the suggested mathematical relation for estimating absolute viscosity from penetration measurements, particularly over the ranges here under consideration.[3] Numerous investigations on asphalts prove that there is no relation between needle penetration and absolute viscosity.

Viscosity Changes Vary. Temperature susceptibility is an inherent property varying considerably for different types of bituminous substances. By temperature susceptibility is meant the change in viscosity of a material with changes in temperature. At temperatures where the viscosity is very high, a rapid change in viscosity is usually observed for a relatively small change in temperature. At temperatures where the material is more fluid the change in viscosity with temperature is not so extreme.

Attempts to relate some function of viscosity with temperature to give a valid practical measure of change in viscosity with temperature has frequently been tried. Obviously, from the above, plotting viscosity against temperature cannot give a linear curve. Plotting on logarithmic scales may provide linearity at least over relatively short ranges. One relation which has found wide acceptance was suggested by Nevitt and Krchma.[4] They propose use of the equation:

$$S = .221\left[\frac{\log (V_1 + 0.8)}{\log (V_2 + 0.8)} \div \log \frac{T_2}{T_1}\right]$$

Viscosities must be expressed in centistokes and the temperatures in degrees absolute. The authors report that softening point-penetration index is erratic, and that other proposed indices are not reliable even over short temperature ranges.

ASTM Charts Permit Plotting. ASTM has made available charts based on this double log relationship to permit easy plotting of viscosities at different temperatures, which will approach linearity over practical temperature intervals. The numerical slope of the curve provides a means of representing the temperature susceptibility of the material.

Nevitt and Krchma conclude that the viscosity-temperature susceptibility has no necessary bearing on quality for specific use and that no correlation can be suggested between desirability of product and temperature susceptibility except where change in viscosity with change in temperature is the sole factor to be considered.

Evaluate Nature of Flow. Certain considerations should be kept in mind in dealing with these values. In the

About the Author

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first place, Newton defined viscosity as the constant ratio of shearing stress to rate of shear. In other words, a Newtonian fluid, that is, one which exhibits Newtonian flow and lack of yield value, will always exhibit the same viscosity no matter what stress is used to measure the viscosity. When the force used to make the measurement is increased, the rate of shear increases in direct proportion so that the ratio is always the same, independent of the experimental measuring force.

Now when non-Newtonian materials are encountered, it is found that the result obtained in making a viscosity determination will vary with the force used to make the measurement. Sometimes shearing stress divided by the rate of shear will not be constant but will be linear over part of the range when shearing stress is plotted against rate of shear. If the linear portion of such a curve is extrapolated to the shear stress axis, the intercept is the apparent yield value —the force which must be exceeded before the material will start to flow.

At temperatures well above the softening point most bituminous materials, and certainly the coal tar enamels, behave like Newtonian liquids. They have true constant viscosities, they become fluid rapidly with increase in temperatures, and upon being poured at the appropriate fluidity to produce the prescribed thickness, they drop rapidly in viscosity and set quickly upon cooling. But when these materials approach the softening point, and certainly when they are below softening point temperature, the rheological characteristics change from Newtonian to non-Newtonian. Here the filler content has a considerable influence in making these extremely viscous coatings more resistant to flow. As the temperature continues to drop, therefore, the coating gets more and more resistant to flow and simultaneously develops higher and higher yield values.

Watch Test Results. If attempts are made to measure the "viscosity" at conditions approaching service temperatures, it is apparent that the numerical value obtained for the "viscosity" will depend upon the stress used to make the measurement. Theoretically, if a million different stresses were brought to bear separately on a coal tar enamel, at sub-

FIGURE 3—Good coating specifications mean longer life. This is the interior of a 48-inch water pipe line after 28 years of service. Brush marks in lining are still visible in 1953. Samples analyzed in laboratory showed no change in physical properties nor water absorption.

grade temperatures, a million different "viscosity" results would be obtained. Now since temperature susceptibility depends upon some function mathematically relating constant absolute viscosity and temperature, it is obvious that one cannot assign values denoting temperature susceptibility to these materials under service conditions. At best one can only report rheological properties observed under stated experimentally applied shearing forces.

Occasionally penetration ratios have been used to indicate temperature susceptibilities. This approach is purely empirical. It depends essentially upon measuring the penetrations at two different temperatures for materials previously found, time after time, to have given good service performance for a particular application. It should be kept in mind that another material which also gives excellent service in the same application may have entirely different penetration as well as other physical properties. Any such empirical relations should be set up in view of the service performance and history for a known given type of material. The requirement may not safely be applied to any other service, or to presumed equivalent products belonging to a different class of material.

Low temperature crack test is performed by putting a coated plate in a low temperature box for several hours, as specified, and determining at what temperature cracks can be observed. The higher the penetration of the material, the lower the temperature to which the undisturbed sample may be lowered in this laboratory test without incipent cracking. There is no correlation between the low temperature crack test and field performance.

It has been suggested[5] that coated pipe may be handled with customary

precautions and proper equipment in the field at temperatures down to about 20° above the specification low temperature crack test temperature. Use of glass reinforcement or saturated asbestos felt wrappers or both, aid considerably in preventing cracking of enamelled pipe when handled at low temperatures. If the coated pipe can be buried and back-filled before the on-set of low atmospheric temperatures, there is nothing to fear about low temperature cracking of the coating.

Consider Service Temperatures. The particular enamel specified for a given job, therefore, should be selected after consideration of the probable high and low temperatures anticipated before the coated pipe is covered. Suitable softening points should be specified to avoid sag at high temperatures in the summer or in warm regions. Penetrations should be so specified to prevent cracking during the winter or in cold areas.

Specifications Field-Proven. It should now be recognized that the above considerations provide no guarantee of good performance in the field. Other factors are of prime importance.

Good service performance for different classes of materials at first had to be established by accumulation of good performance records. It was found that coal tar enamels having certain properties performed well under certain service conditions. Recommended values for these properties—or specifications—therefore, assure the corrosion engineer that coal tar enamels having these particular physical properties will perform the same as similar products made and used successfully years before.

Good Coating Properties Proved. What is necessary to establish a protective coating as a standard material? A good protective coating for subsurface, prolonged satisfactory use must provide electrical insulation for the anticipated life of the installation. It should also be generally available.

High electrical resistivity can be readily measured in the laboratory under specified conditions and methods of test. But, most important of all, is the requirement that the high electrical resistivity must be *permanently* high. If the resistivity drops, with relatively short terms of service, either the pipe will corrode and possibly perforate, depending upon the severity of the environment, or additional cathodic protection will have to be applied. With continued drop in the coating's electrical resistivity, greater costs will be encountered as current demands mount and cathodic protection installations have to be enlarged and multiplied.

Low Water Absorption Vital. Associated with permanent high electrical resistivity is resistance to water absorption. This can be determined readily in the laboratory but can only be sensibly evaluated by long-term immersion. If coatings exhibit appreciable absorption of water with prolonged time of immersion, their electrical resistivity starts to drop. Coal tar enamels have been immersed for years by different manufacturers and consumers, and always exhibit a very low total water absorption. The value obtained within the first year and maintained constant for several years thereafter is barely more than one gram per square foot.

Water absorption tests are run by completely immersing weighed, coated steel panels in gently flowing water, and removing them to be weighed periodically. The amount absorbed can be calculated from the weights and area involved. Probably 3 to 5 years are necessary to assure good performance in the field.

It is interesting to note that Spencer and Footner[6] state that water absorption of bituminous pipe line coatings varies and increases with increased penetration and is independent of the type of material. This is startling in view of successful results achieved with high penetration of coal tar enamels which meet AWWA specifications used to protect interior of water lines.

Other tests that may be run in the laboratory in studying fundamental performance properties of enamels are resistance to soil stress and resistance to specific chemicals with which, through accident or environmental factors, the coating may come in contact. There are no standard methods for conducting a soil stress test, but considerable work is now being done in this field in different laboratories and it is quite likely that a standard method may soon be available.

Presently most laboratories subject samples of coated or coated-and-wrapped pipe to the effect of a known "hot soil," or a synthetic bentonitic clay mixture, during successive wetting and drying periods. At the end of each wet-and-dry cycle, the condition of the coating is evaluated by visual inspection and by application of an electrical holiday detector. Similarly coated specimens may be subjected in the laboratory to immersion in types of chemicals which may possibly contact the coating in service. Usually physical inspection will provide information as to whether the coating will be suitable in the environment anticipated.

Tests Take Time. These tests on fundamental coating properties are all time-consuming. They cannot be applied to material as manufactured and shipped for use shortly thereafter. There are no accelerated tests which may be applied to coal tar coatings, or other hot applied coatings, which will tell the analyst whether the sample under consideration will exhibit permanent high electrical resistivity and permanent low water absorption characteristics during long-term service exposure.

Specification tests and properties insure the consumer that suitable material can be obtained providing a proper basic type has been specified. Satisfactory fundamental insulation properties together with a past history of trouble-free performance assure both manufacturer and consumer that the proper basic type of coating is being procured. Specification tests insure required batch and shipment reproducibility, and widespread availability of standard material. To fortify the specifications and recommended requirements, the integrity of the supplier, constant raw material availability, good product distribution and the technical knowledge of the manufacturer are of prime importance.

REFERENCES

[1] American Water Works Specifications C203—Standard Specifications for Coal-Tar Enamel Protective Coatings for Steel Water Pipe sizes 30 inches and over; and C204—Standard Specifications for Coal-Tar Enamel Protective Coatings sizes up to 30 inches.

[2] Report of Committee T-2G on Coal Tar Coatings for Underground Use—Corrosion, 12, No. 75, (1956).

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[4] Nevitt and Krchma, Ind. Eng. Chem., Anal. Ed., 9, 119 (1937).

[5] Shideler, North-East Regional Meeting, N.A.C.E., November, 1955.

[6] Spencer and Footner, Chem. & Ind., May 7, 1955, p. 448.

See what your dollar buys when you . . .

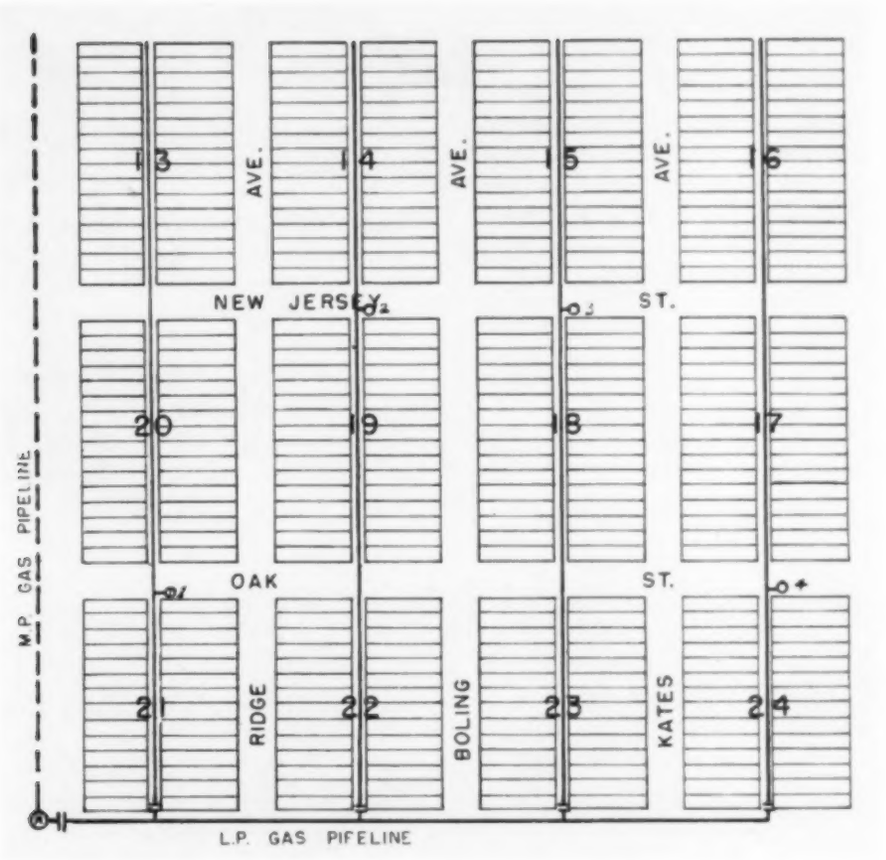

FIGURE 1—Portion of a city atlas page showing the anode location, insulating points and line location. This type layout used for city distribution systems may also be adapted for transmission lines. Notice that the anodes are numbered for cross reference on the anode history card.

Keep Tab on Corrosion Control Program

First step in engineering a corrosion control system calls for attention to details before and during construction. Once the line is operating, a complete set of records will indicate performance and the economics of protection.

By **O. W. EVERETT,** Oklahoma Natural Gas Company, Tulsa

ANY CORROSION CONTROL system must be coordinated with construction and maintenance to be most effective. This calls for close cooperation among corrosion engineers, construction superintendents, design engineers, surveyors, inspectors and maintenance foremen.

Proper planning ahead of construction will eliminate many problems. Within economic limits, a majority of corrosion cells can be prevented and those that do occur can be isolated from their environment. Special care should be given during the planning phase to the layout of the right of way.

If possible, always avoid such areas as cinder beds, salt spots, severe alkali soil, waste and sewage disposal drainage, chemical or fertilizer effluent, foreign rectifiers and electric railways.

It may be impossible or impractical to avoid all of them; if so certain corrective measures must be taken. In contaminated soil areas extra care should be exercised in coating the pipe; clean soil should be used for backfill. If a foreign rectifier cannot be avoided, satisfactory arrangements must be made with the owner for mutual tests and corrective measures. An insulator should be installed 500 feet on each side of an electric railway crossing to minimize the problem of stray current effects.

Problems of routing a pipe line around probable corrosion areas have been reduced greatly by the ability to isolate the metal from its environment. A number of satisfactory coating and wrapping methods have been

devised. One system should be chosen before construction and clear specifications written.

Install Adequate Test Leads. A program of installing a sufficient number of the proper type of test points along a line is a must to a corrosion control program. A good plan to follow with test stations is to designate them as Types *A*, *B*, *C*, *D* etc. Type *A* is a single wire for taking pipe-to-soil potential readings; Type *B* has four wires with taps on line in pairs at 50-foot spacing for observing long line currents; Type *C* is also a four wire station—two on each side of an insulating point for testing or bonding insulation; and Type *D* is a test point between two pipe lines. Wires in each of the various test stations should terminate in a junction box or at a test block with a weather-proof cover.

Coordinate Maintenance and Corrosion Planning. The problem of maintenance to existing installations should also be coordinated with the corrosion control program. Here a well-kept set of leak records is a valuable contribution. Records should include the type, cause, and location of a leak; the type and cost of repair is also desirable information.

ANODE HISTORY
FORM 725

ESTIMATED TIME OF EXPIRATION

1972 1971 1970 1969 1968 1967 1966 1965 1964 1963 1962 1961 1960 1959 1958 1957 1956 1955 1954 1953 1952

Weight _____ J F M A M J J A S O N D

P-S READING		ANODE DRAIN		
DATE	LOCATION AND READING	Milliamperes	Ma. Years Since Last Reading	Total* Milliampere Years

* A 17-lb. anode should produce 1000 Ma. for 1 year, 100 Ma. for 10 years etc. Others produce according to ratio of weight. Thus 5 lb. = 295 Ma. years, 9 lb. = 530 Ma. years, 32 lb. = 1825 years.

FIGURE 2—Pertinent anode data is kept on the front of this history card. Pipe-to-soil potentials, anode current drain and estimated life are logged.

GENERAL LOCATION _____

Plat No. _____ Anodes Nos. _____

Wire Markings—Anode _____ L.P. _____ M.P. _____ Other _____

Anode Data—Size or Type _____ Cover _____

Curb Box or *Terminal Location _____

_____

Backfill _____ Soil Resistivity _____ 4 Pt. ☐ Prod. ☐

Pipe Protected _____ Feet _____ Miles _____

Type Coating _____

Coating Resistance _____

Remarks _____

Installed by _____ Date _____ 19____

*(If no terminal exists enter exact anode location)

FIGURE 3—The back side of the history card is used for recording anode location, type and size. Line size and length under protection is also noted.

Effective Corrosion Control Demands Good Records. After the corrosion control system is installed an effective program of monitoring must be put into use. This should be a definite well-planned program.

First consideration should be given to records. Maps are commonly used to record the location of lines and to locate anodes and other pertinent data. Figure 1 shows a portion of a city atlas page containing this information; note the various symbols. The two lines bisecting the pipe line denote an insulation point. A line normally drawn in red designates a line under cathodic protection. A circle with a number in it shows the anode mapped in its proper location.

In record keeping the anode number, along with the atlas page number, is used as a cross reference to an anode history card. Figure 2 shows one side of this card where data such as pipe-to-soil potentials and anode current drain is recorded. Figure 3, the other side of the card, details information such as location, type, and size of the anode. Size and amount of pipe under protection is also recorded on this side of the card.

Although this example is for a distribution network, similar records may be used on a transmission system. There, instead of atlas pages, a map of the original survey is used; Anode history cards are the same as those used in distribution work. Rectifier locations are placed on a separate drawing according to the survey. Figure 4 shows a typical drawing.

Figure 5 shows one side of a form used by general office personnel when making annual rectifier inspections. All data pertaining to unit instruments are recorded on this side of the sheet. The other side of this form shown in Figure 6 is used for recording the various tests made of the equipment, including the ground bed.

Post Cards Carry Field Test Readings. Semi-monthly checks are made by the men in the field and recorded in a log book in the rectifier and on double post cards, such as those shown in Figure 7. One side of the card is mailed to the district headquarters; the other to the general office. Information from the card is posted to a running time record and to a graph which clearly points out the efficiency of the unit.

A single post card (Figure 8) is used to record monthly readings ob-

served on permanently installed indicating pipe-to-soil volt meters. It is mailed to the district office when filled in. If readings indicate that cathodic protection is low, a technician is notified so he can make necessary corrections.

Pipe-to-Soil Records Are Vital. One of the most important records is detailed on a form known as a pipe-to-soil check point sheet such as the one shown in Figure 9. At convenient points, usually a meter riser or test station, pipe-to-soil potentials are observed using a portable meter. Location of test points, length and size of pipe under protection are recorded here also.

Typical test procedures generally follow this outline:

1. Lines monitored by permanently installed indicating meters are to be checked by reading meters at least once a month. All meters should be tested twice a year.
2. Fully protected lines (usually coated ones) not monitored by permanently installed indicating meters are to be checked by taking appropriate pipe-to-soil voltages regularly:
   - Lines 1000 feet long or over and important short length of lines, such as creek crossings,

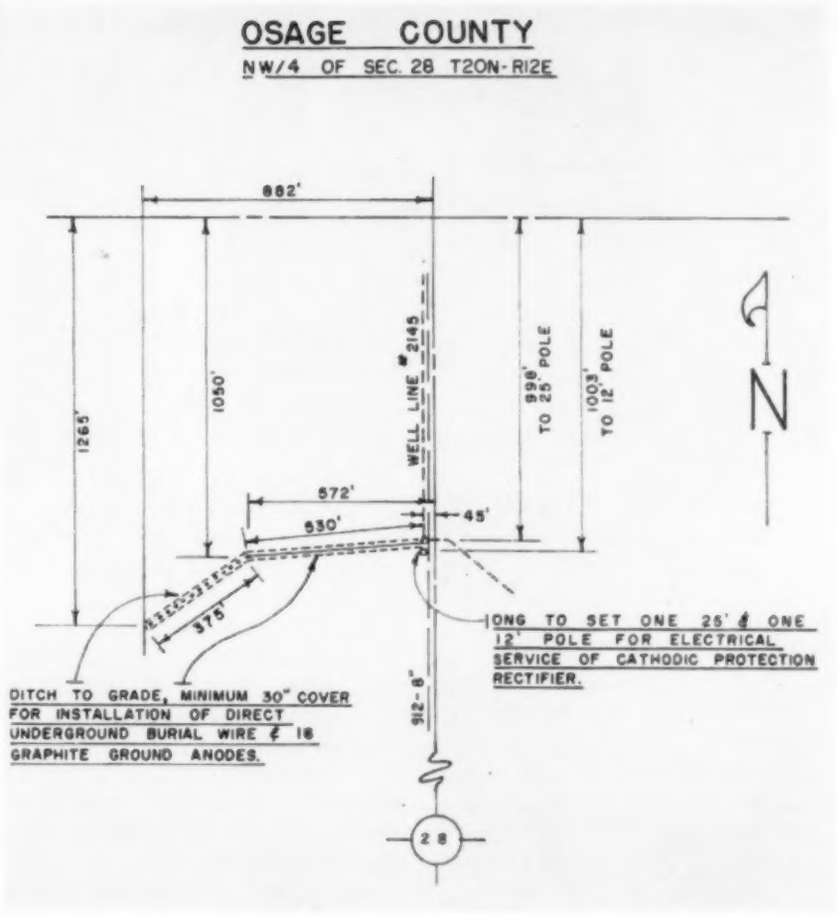

FIGURE 4—Plat of a typical rectifier location. Transmission system uses map of the original survey instead of pages to keep records.

RECTIFIER REPORT

Form 1707

ANNUAL

Date_____ Rectifier No._____ Location_____

Town Nearest Rectifier_____

Brand_____ Name Plate Rating_____ Serial No._____

AMMETER TEST

Make_____ Size_____ Round ☐ Square ☐ Panel Drilled For_____

Red Lined at____ Amps. Type & Size of Shunt_____

Range_____ Amps. Meter Switch_____ Found Meter Reading_____

Test Meter Read_____ Left Meter Reading_____

VOLTMETER TEST:

Make_____ Size_____ Round ☐ Square ☐ Panel Drilled For_____

Red Lined at____ Volts Range____ Volts Meter Switch_____

Found Meter Reading_____ Test Meter Read_____

Left Meter Reading_____

TIME METER DATA:

Make_____ Size_____ Round ☐ Square ☐ Panel Drilled For_____

Reading_____

R.E.A. DRAIN METER:

Make_____ Size_____ Round ☐ Square ☐ Panel Drilled For_____

Type & Size Shunt_____ Range_____ Meter Switch_____

Found Meter Reading_____ Test Meter Read_____

Left Meter Reading_____

K.W.H. METER:

Power Company_____ Address_____

Meter Constant (kh)_____ Reading_____

FIGURE 5—Front of annual inspection form shows all pertinent data concerning instruments in the rectifier.

CONVERSION EFFICIENCY:

With .8 ohm Register

D.C. Volts x Amps. / A.C. WH Input = _____ / 3600xKh = _____ = _____ %

Voltage Tap Positions_____

Normal Load:

D.C. Volts x Amps. / A.C. WH Input = _____ / 3600xKh = _____ = _____ %

Voltage Tap Positions_____

RECTIFIER STACK TESTS:

Forward Drop Across Plates _____ Volts Total

_____ Volts Per Plate in Series

Reverse Current Flow_____ Amps. Total

_____ Amps. Per Plate in Parallel

Power Consumption Idle_____

GROUND BED TO SOIL RESISTANCE:

$\frac{E}{I}$ = _____ = _____ ohms Electrode_____ Ft. From Rectifier

PIPE TO SOIL RESISTANCE:

$\frac{E}{I}$ = _____ = _____ ohms Electrode_____ Ft. From Rectifier

PIPE TO GROUND BED RESISTANCE:

Total Above_____ or R = $\frac{E}{I}$ = _____ = _____ ohms

LIGHTNING PROTECTION:

Number Arrestors _____ Type_____ Brand_____

Connected to_____

FUSES, CIRCUIT BREAKERS, ETC.:

Pipe to Soil Voltages Immediately After Shutting Rectifier Off:

Amp.	Volts	Normal P-S Voltage	Off P-S Voltage

Remarks

Attach Plat of R.E.A. Neutral to Soil Voltages for at Lease One Mile

FIGURE 6—Back of annual inspection form shows results of tests conducted on rectifier plus the performance of the ground bed and circuit breakers.

1778 - 1

Rectifier No. _____ Location _____

Date Volts Amps Hours REA* Observer

REMARKS:

*Only where power meter has speedometer type dial.

FIGURE 7—Post card mailed semi-monthly to the main office gives information necessary in figuring the efficiency of the unit. Information is also recorded on log in the rectifier.

1748 - 1

Indicating Meter: Location _____

Date Meter Reading Observer

REMARKS:

FIGURE 8—A typical post card used to report the monthly pipe-to-soi potential. Report is mailed to district office—technician is notified if readings indicate malfunction.

should be checked at least once every three months.

- Short lengths of lines should be checked at least once every six months.

3. Anode groups on bare lines (which are generally hot spot protected) should be checked by surface potentials at least once a year.
4. Anode drains should be checked on bare lines as follows:
   - Once a year when surface leads have been provided.
   - Once every three years when surface leads have not been provided, except when one anode per group or one anode along a line has been provided with lead wires to permit the testing of representative anodes.

Rectifiers should be inspected semi-monthly by district personnel and annually by the engineering department. One inspection each month is to be made by the chief cathodic protection inspector in the district. The other may be made by the chart changer.

Monthly Inspections Catch Faults. Once a month the cathodic protection inspector completes this series of checks: He carefully completes the regular post card (Figure 7) showing all information indicated.

Under "remarks," submit the following:

1. Power company's neutral to ground potential at the point where reading is usually the lowest.
2. Condition of rectifier stacks. This may be determined by standard efficiency test. Also observe heating, peeling, or cracking of plates.
3. Pipe-to-soil potentials near the ends of the protected system.

Monthly inspection by other personnel should be made submitting only the information asked for on the card. Annual inspection by the engineering department should be made by the general inspector accompanied by the district inspector and should include a thorough testing of the rectifier and the protected system.

FORM 1708

PIPE-SOIL POTENTIAL TESTS

TOWN _____ ANODE NO. _____ FT. _____

LOCATION _____

ATLAS PAGE _____ LINE NO. _____

CHECK TYPE OF METER P.S. ☐ INDICATING ☐

Date	P.S. Reading	Date	P. S. Reading

FIGURE 9—Another form provides for the tabulation of pipe-to-soil potential readings taken at convenient points along a transmission line. Lines are checked on predetermined schedule and location of checkpoint is noted on sheet.

About the Author

O. W. EVERETT has been engaged in corrosion work for Oklahoma Natural Gas Company for eight years. At present he is general cathodic protection supervisor and recently served as chairman of the Eighth Annual Pipeliners Short Course of the Tulsa NACE Section for 1957. Everett attended Oklahoma A & M College and is a member of the Tulsa Engineers Club.

ACKNOWLEDGMENT

Discussion given at a Corrosion Control Short Course at Norman, Okla., sponsored by the College of Engineering and the Extension Division, University of Oklahoma, and the Central Oklahoma Section, NACE.

Let's Look at Electrical Grounds

Problems of grounding electrical equipment require careful study. Here is a practical approach that makes use of grounds that are "ready-made."

By **W. H. STEWART,** Sun Pipe Line Company, Beaumont, Texas

FOR YEARS the grounding of electrical equipment has followed a more or less standard procedure. In new construction and in converting existing systems to electrical operations, grounding systems have usually ended with a terminus at one or more ground rods, often copper.

Petroleum is handled through a maze of buried piping. On a pipe line system, thousands of feet of various pipe sizes are buried below ground. Thus, it seems rather odd to ignore this network and bury copper "grounds" adjacent to existing pipe.

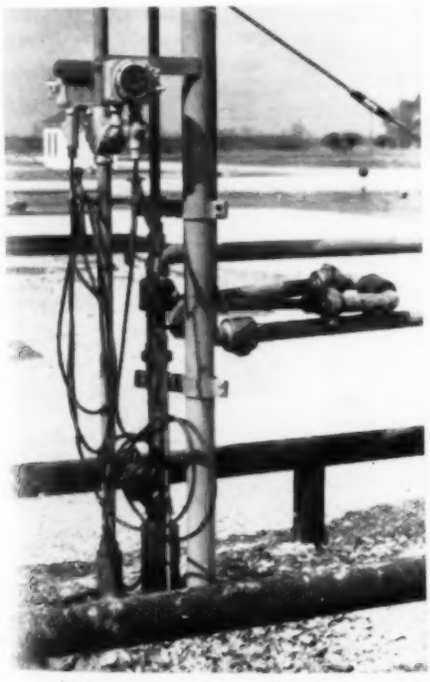

FIGURE 1—Typical installations for bringing the carrier to equipotential with the stationary piping. This acts as a safeguard against static electricity accumulating on an ungrounded truck.

This copper ground practice seems to prevail on various types of facilities from 500 horsepower pump motors to ⅓-hp water pumps. Even though the 500-hp motor is an integral part of a complete station on a continuous pipe line and the ⅓-hp water pump is on or near a well casing of appreciable depth, investigation frequently reveals a "ground rod" installed nearby. A study of the "code" actually reveals this to be the method of last resort.

Copper Rod Can Cause Corrosion. Not only do such practices create galvanic corrosion cells, but they fail to come anywhere near the grounding efficiency of a direct connection to the piping system. Corrosion possibilities are by no means negligible. Copper ground plates or rods placed near steel pipe or other buried equipment create a potent cell that will cause rapid pitting of the steel if not checked.

Measurement of resistance of a ground rod is not a strict quantitative procedure; the net result of "megging" a made ground is to give a relative value of the earth resistance immediately surrounding the rods involved.

Grounding Necessary. Pipe line operations have numerous grounding problems ranging from butane tank trucks and pump stations to tanker loading facilities.

Voltages in the static grounding of tank trucks are extremely high but very small currents are involved. Here switches and cables with very good insulation but low current carrying capacity are needed.

Figure 1 shows a typical installation for bringing the carrier to equipotential with the stationary piping and equipment. This is simple insurance against static electricity accumulating on an ungrounded truck and discharging to connections either in coupling or uncoupling the vehicle.

Figure 2 shows a tanker grounding installation. In this type of installation the static electricity problem has been given much more attention than is necessary. Tanker grounding problem is more basic and involves voltages far lower than any classed as "static."

There is a basic hazard present in making and breaking hose or other conducting connections to a tanker. With no external factors present, the ship hull being connected metallically to shore facilities creates a galvanic cell and causes a flow of current to be set up. When this flow is inter-

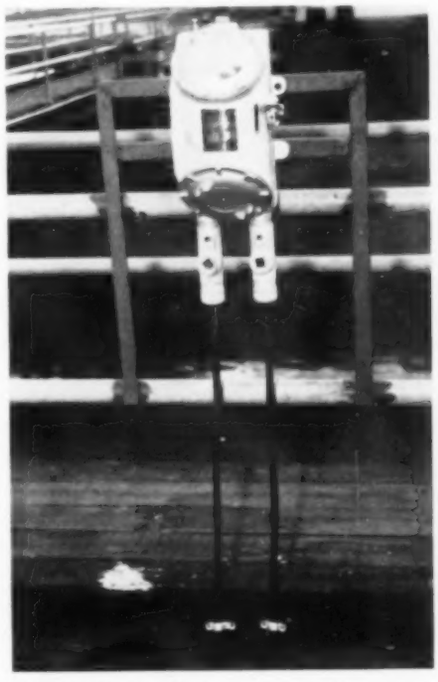

FIGURE 2—Installation of grounding switch for tank ship or barge. This grounding problem is more basic and involves voltages far lower than those classified as "static."

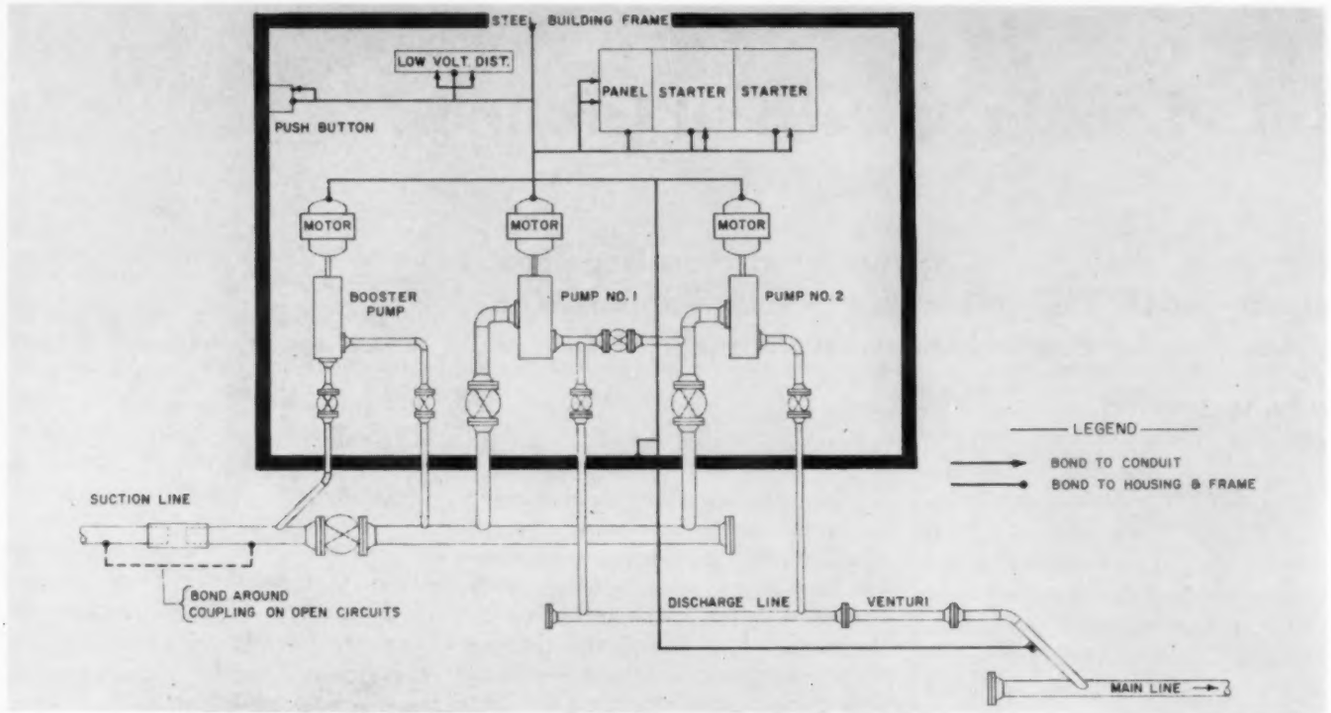

FIGURE 3—An efficient grounding circuit for an electric pipe line pumping station. Note that the final grounding junction for the grid in the station is the pipe line itself. Building, starters and motors are all tied together.

rupted, an extremely dangerous arc is created.

Added to these natural causes of current flow may be an additional source of current from rectifiers or other cathodic protection units operating on the shore facilities. At times these currents reach values of rather high amperage, creating even a more dangerous hazard in making and breaking metallic connections aboard ship.

Simple Safety Rules. A few simple rules coupled with use of proper equipment eliminates these hazards. Figure 2 illustrates a typical ship grounding set up. Note that the cable and switch are designed to carry heavy currents at extremely low voltages.

Follow these steps to ground a vessel properly.

1. Dockman must ascertain that switch is in the open position, while the ship is being tied up.
2. Prior to taking hoses or other equipment aboard, the ground cable is passed up and terminal is bolted to designated lug on vessel.
3. Switch is now closed and loading or unloading is carried out.
4. Hoses and other equipment are disconnected and returned to the dock.
5. Then the switch is turned to the open position, the cable disconnected and removed from the vessel.

These steps in no way affect or mitigate the potentials created on the surface of hydrocarbon products within a tank during filling.

Maintain Continuity. This brings us to the third category, electrical equipment grounding. Figure 3 shows an installation where the final grounding junction for the grid in the station is the pipe line itself. All equipment, including the building, is so gridded together that removal of any part or parts of the installation does not interrupt electrical continuity to ground of the remaining equipment. Nor does the system depend upon electrical continuity through conduit, related bushings and other fittings. All switch cabinets, motor frames, conduit, and appurtenances are bonded to the ground network which terminates at the pipe.

To eliminate any corrosion cells, this ground network is insulated from earth until it terminates at the lug on the pipe line.

The question of the coating on underground piping may arise as a factor in the consideration of grounding problems. Any test applicable to checking "made" grounds will reveal that the resistance of most buried pipe systems is far below any such made grounds.

Use Common Sense. By the very nature of the physical properties involved, an extremely efficient effective grounding system far beyond the capabilities of any "made" grounds has been produced. Common sense applied to the problem not only belies the "old wives tales" of procedure but provides effective protection for both men and equipment. —**The End**

About the Author

W. H. STEWART is a corrosion engineer for Sun Pipe Line Company's Crude Lines division. He was a member of the original committee that later became NACE. He was first chairman for the NACE Committee T-2 on Pipe Line Corrosion. He was named vice president of NACE in 1956 and is now president-elect.

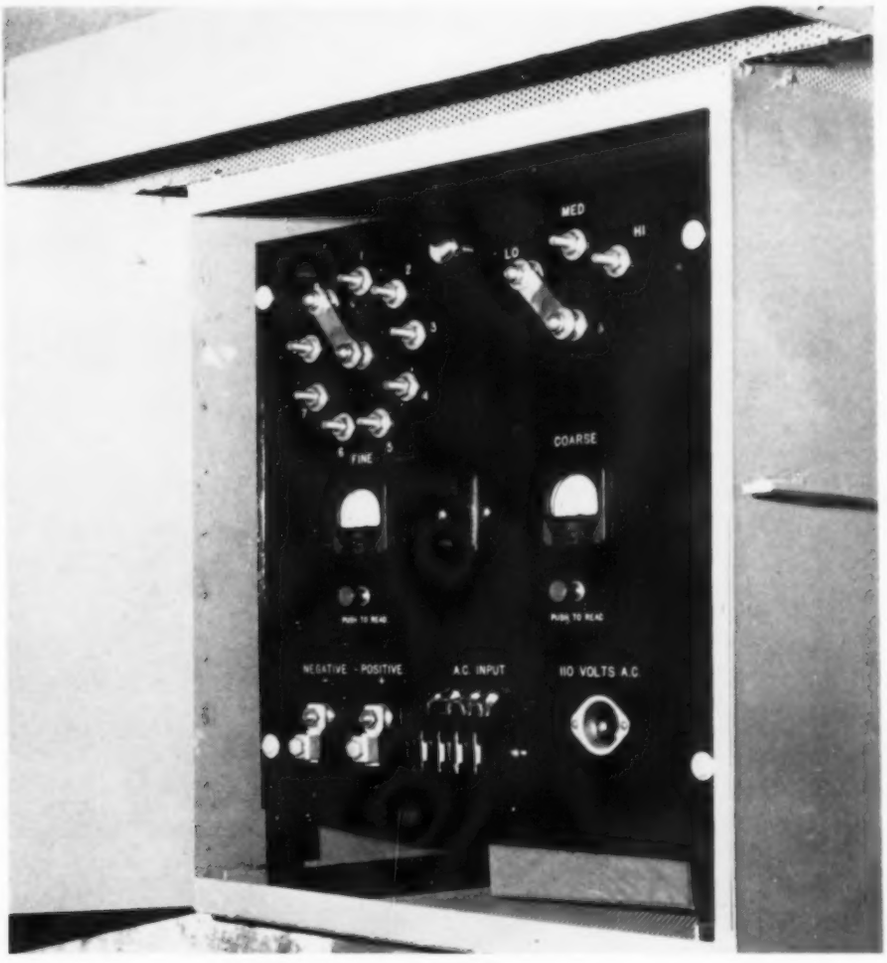

FIGURE 1—Transformer output taps, switch and meters, AC terminal block and DC lugs are all conveniently mounted on the control panel of this air-cooled rectifier.

Take the Mystery Out of Rectifiers

Knowledge of basic operating principles, rating limits and design features will lead to top performance. To get the best service from today's rectifiers, take advantage of manufacturer's recommendations.

By **WAYNE JOHNSON**
Corrosion Rectifying Company
Houston

USE OF RECTIFIERS to supply current for cathodic protection of pipe lines has grown rapidly in the past few years until now thousands of systems are in operation. In spite of widespread application, units are very often improperly engineered or abused in service. A better understanding of the fundamentals of rectifier design and construction will lead to top performance under proper conditions and loads.

Cathodic protection rectifiers are sold in a variety of sizes, capacities and styles. This raises the questions—

What requirements should a good rectifier have to meet? . . . What should I look for in the unit I propose to use?

The most common type of rectifiers in use today—the selenium oxide and silicon diode—are made up of basic units consisting of two dissimilar conducting materials whose junction has assymmetrical conductivity. This simply means that it allows electric current to flow in only one direction to produce in effect a rectified direct current. Schematic hookups and resulting wave forms for several differ-

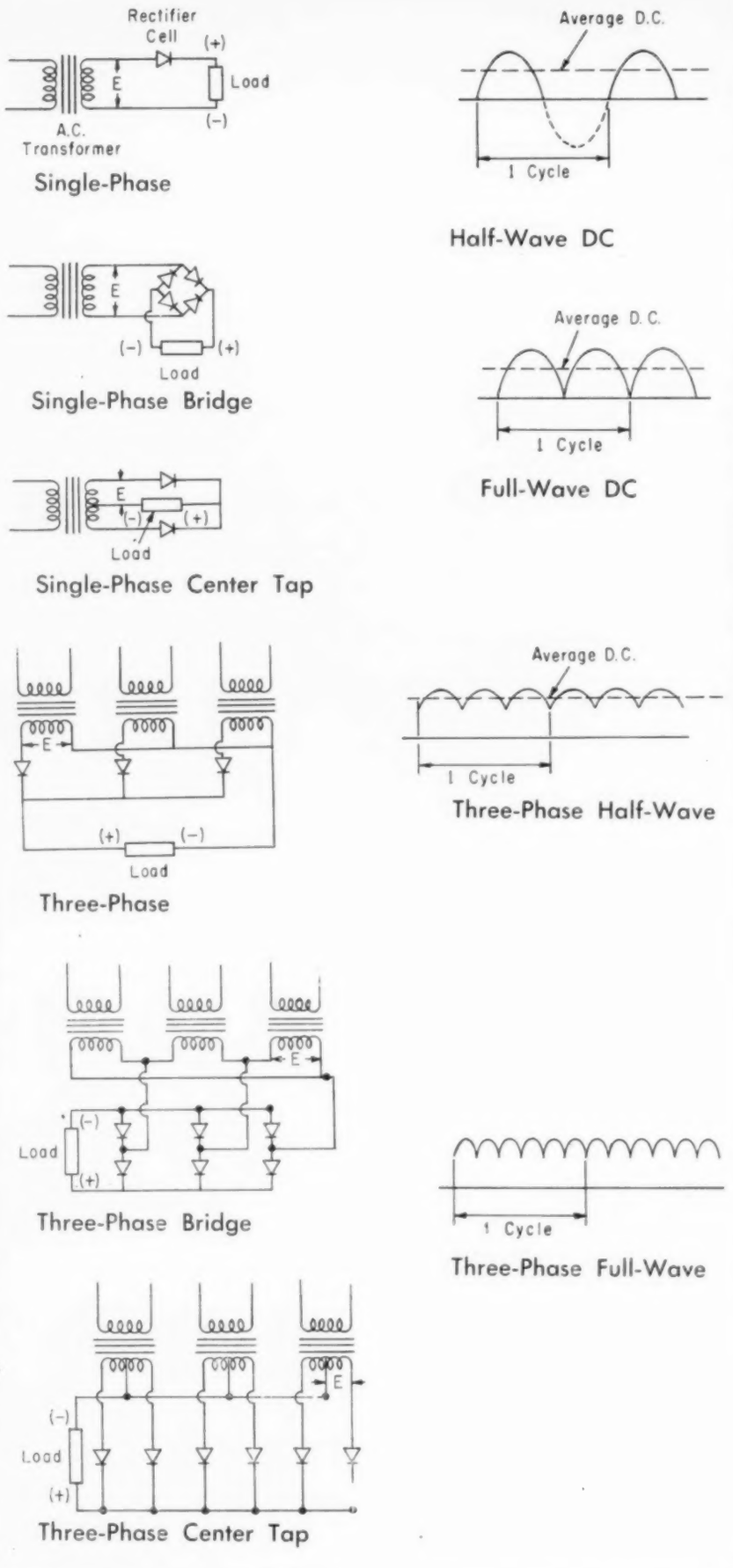

FIGURE 2—Wiring schematic and wave form sketches for six commonly used pipe line rectifiers.

Special Corrosion Report . .

ent type rectifier designs are shown i Figure 1.

Generally full-wave rectification i used in pipe line protection system because of its efficient full wave form When three phase power is available the bridge circuit is often employe because rectified three-phase powe has a smooth and efficient wave factor

Typical characteristics of these cir cuits are given in Table 1. Input AC (root-mean-square) voltage divided b the appropriate form factor gives th no load DC voltage output that ma be expected. A lower form facto means greater current capacity for a given voltage input. However, as load current increases voltage loss will oc cur in the transformer, rectifier plate and interconnecting wiring, thus th actual load voltage is a function o load. Conventional rectifiers utilize multitap transformers to allow control of the output voltage.

Theoretical maximum volt-ampere efficiency is calculated as follows:

$$\text{Conversion efficiency} = \frac{E_{dc} \; I_{dc}}{\text{AC Watts Input}}$$

These theoretical values are never realized due to losses in the rectifier plates. Maximum single phase efficiencies for resistive loads are about 65-70 percent; for three-phase rectifiers these values are about 75-80 percent.

What Does Rectifier Rating Mean?

Rectifier cells are rated according to their maximum voltage and amperage capacities. Current rating of a rectifier element must depend upon the

Editorial Index Available

A complete editorial index covering all issues of PIPE LINE INDUSTRY published during 1956 has been compiled and bound separately in convenient pamphlet form. It will be sent free to all subscribers requesting copies.

To get your copy, address orders to the Librarian, Gulf Publishing Company, Post Office Box 2608, Houston 1, Texas. Or if you prefer, you can use the convenient Readers' Service Blue Postcard on the last page of this issue. Just check the square indicated. Fill in your name and address. Drop the postage-paid card in the mail and the index will be sent you.

Act now. The supply is limited.

area of the rectifying surface and the ability of that area to dissipate heat losses.

Heat dissipation may be accomplished by several methods. Control of spacing between plates is one most commonly used; Extending surfaces in the form of fins is another. Increasing mass flow of coolant over the surfaces is also a proved method of increasing heat losses.

Where air is the coolant used, mass flow can be economically increased by use of the "chimney effect" in the housing design, or forced cooling may be obtained by use of fins and blowers.

Under severe atmospheric conditions or in areas that may be hazardous, rectifiers are often immersed in oil, in which case the current carrying capacity of a given cell usually can be uprated. Adequate cooling surface must be provided by the housing or tank to which the oil can give up heat. Unless adequate cooling surface is provided, plates may be overheated and their useful life decreased.

Voltage Ratings Improved. Voltage rating is determined by that voltage at which the rectifying layer breaks down. Rating of rectifier plates has been increasing during the past decade because of improved methods of manufacture. Whereas maximum (root-mean-square) voltages per cell were about 12-15 volts 15 years ago, plates now available may be rated at almost 2 to 3 times these values.

A rectifier is rated also as to ambient temperature operation. Typical ambient ratings are from 35° to 55° C. but may be made even higher. Derating is usually necessary at higher ambients.

Heat Destroys Rectifier Cells. Excessive heat is quite detrimental to life of rectifier cells. They should be of sufficient capacity (physical size included) to easily handle the load they must bear. Proper spacing between the cells of a built up stack is important, too, whether the rectifier be convection cooled or has a forced cooling system. Air or other cooling medium must be able to circulate about the plates freely. Housings must be large enough to allow circulation of the cooling medium without obstruction. Plates should not be placed close to other heat producing components.

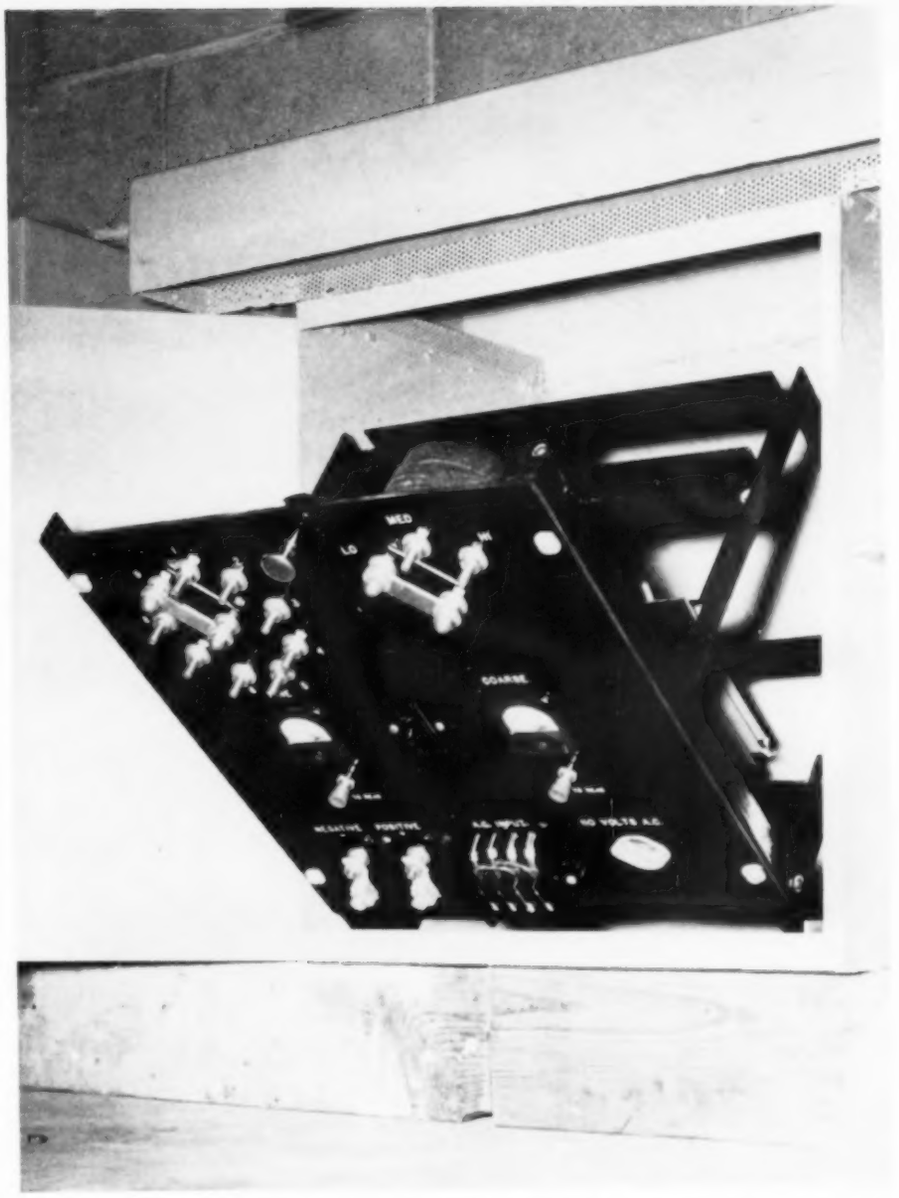

FIGURE 3—Tilt out feature of this air-cooled unit makes all key parts of rectifier quickly accessible for easy maintenance and inspection. Perforated metal screen on under side of housing top allows circulation of cooling air and prevents insects from entering.

Rectifier Cells Age. Rectifiers undergo aging, a term that is applied to the increase in resistance of the cell in the forward direction and a decrease of resistance in the reverse. Aging is not only a function of time, temperature, and load, but it is also a function of the process by which the cell is made. Different makes of rectifiers can thus be expected to have different aging characteristics. In any event, additional transformer capacity should

TABLE 1

CIRCUIT TYPE	SINGLE PHASE			THREE PHASE		
	Half Wave	Bridge	Center Tap	Half Wave	Bridge	Center Tap
Form Factor	2.3	1.15	1.15	.855	.74	.74
Maximum Theoretical Volt-Ampere Efficiency	40.5	81.1	81.1	96.8	99.8	99.8
Minimum No. Cells Required	1	4	2	3	6	6

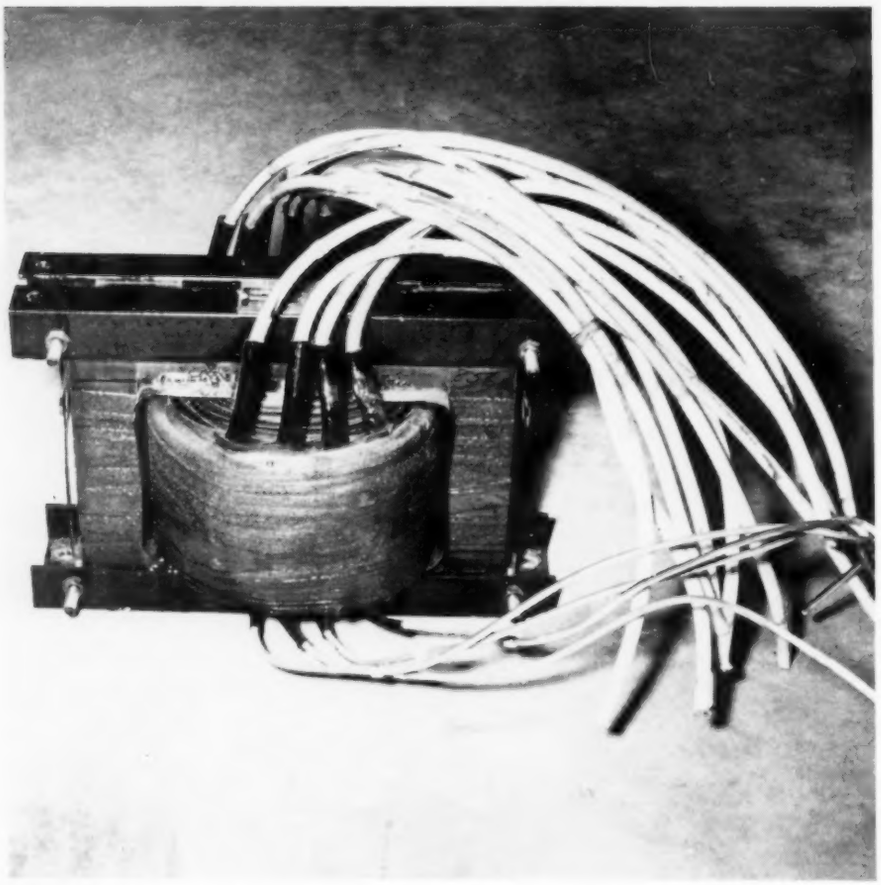

FIGURE 4—Typical single-phase transformer used in pipe line rectifiers. Primary leads are at bottom and secondary at top.

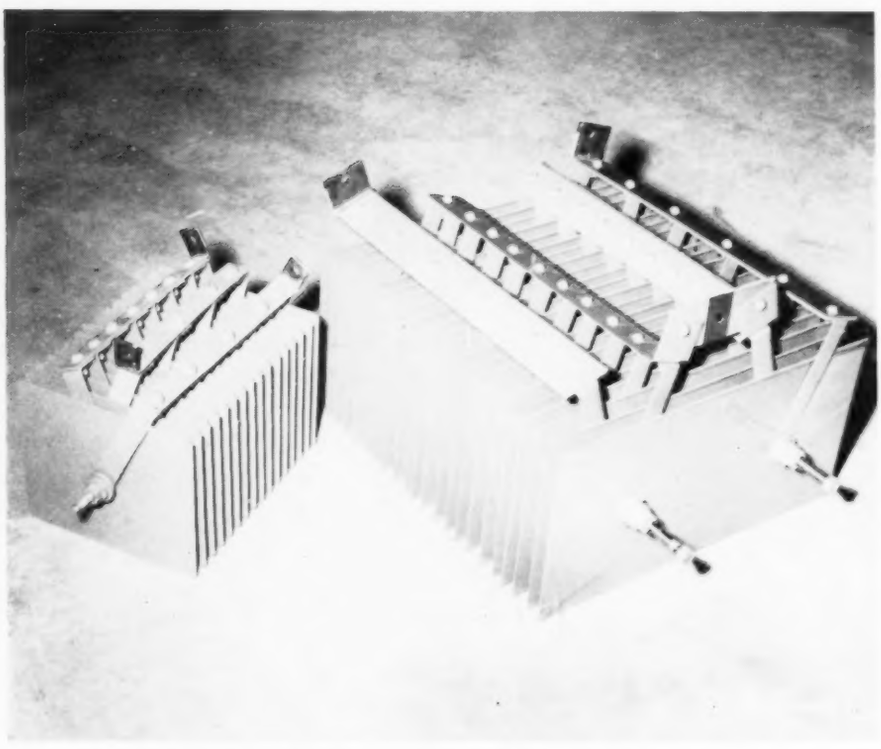

FIGURE 5—Rectifier cells such as these are assembled into specially designed units. Stacks at left are 40 ampere capacity while the larger one is rated at 100 amperes.

be included to assure that full rated DC voltage can be obtained in spite of voltage loss through the plates as a result of aging.

Identify Stacks by Designation. Stack designs are numerous; many different sizes and arrangements are available. They may be identified by the manufacturer using a sequence of numbers.

For example, the designation (4-1-1-B) refers to four cells in a single-phase, full wave bridge, insulated from each other and assembled as one stack. First number in the designation tells the number of rectifying elements in the unit, second—the number of cells in series, third—the number of cells in parallel and fourth—a code designation for the stack connection.

Transformer Design. In order to change the available AC voltage to a more suitable (usually lower) voltage, step-down transformers are used in cathodic protection rectifiers. There are power transformers which have primary voltages of 110, 220, or 440 volts with either single or three phase windings. The secondaries of these iron core transformers are usually rated at from 15 to 100 volts with a number of taps or connections so that there will be a selection of voltages for use.

Transformers consist of the following basic components:

- A high voltage winding
- A low voltage winding
- Insulation between turns and usually from the other windings also.

In addition to these essential parts, commercial transformers also have mechanical bracing for core and coils, a cooling medium (either air or oil) and a protective housing or tank.

After transformer windings are wound around the steel core, or cores, the whole unit is usually dipped in an insulating coating material and baked. This insulates the windings and protects them against moisture.

Watch Transformer Heating. Temperature rise of a transformer in operation is due to the iron loss in the iron core plus resistance of winding conductors. The load that may be placed on the transformer is limited by the temperature of the windings. In general, the temperature should

not be allowed to rise over 55° C. above the cooling medium.

Transformers used in a pipe line rectifier will be essentially rated to match the associated rectifier stack. Due to numerous circuit losses the transformer (and the rectifier stack as well) will need to have a rating higher than the full rated voltage and amperage output of the finished rectifier. It will need to have enough high and low range taps so that proper output adjustments may be made. A typical air cooled rectifier has a series of tap changing bars on the instrument panel. These busses, or bolts, are connected to the transformer secondary and also to the input AC of the rectifier stack. Changing the tap connections, changes the input to the rectifier stack and thus the output voltage of the unit.

Housing Must Allow Cooling. The rectifier housing should be of proper size for cooling with all components located for accessibility. Transformer and rectifier stacks should be mounted on a framework separate from the housing. This assembly should be removable, and in the case of the air cooled unit should slide out or tilt forward so that the interior parts may be inspected and serviced. Housings

About the Author

WAYNE A. JOHNSON, president of Corrosion Rectifying Company and Electronics International, Incorporated in Houston, has been actively engaged in corrosion work for ten years. He has specialized in design and installation of cathodic protection systems. Formerly he was with The Texas Pipe Line Company as a corrosion engineer. A graduate of Texas A & I College, Kingsville, Johnson has been active in NACE and the Houston Pipe Liner's Club and has written various articles on underground corrosion and use of rectifying systems.

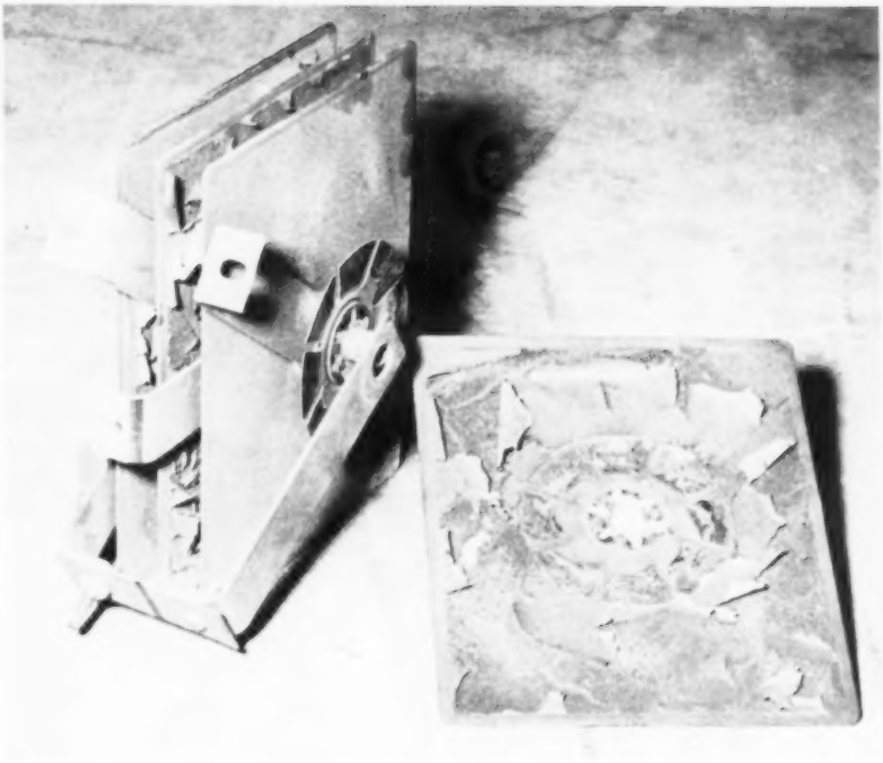

FIGURE 6—Overloading and resultant overheating of rectifier cells is one of the most common operating difficulties. This damaged stack shows the effects.

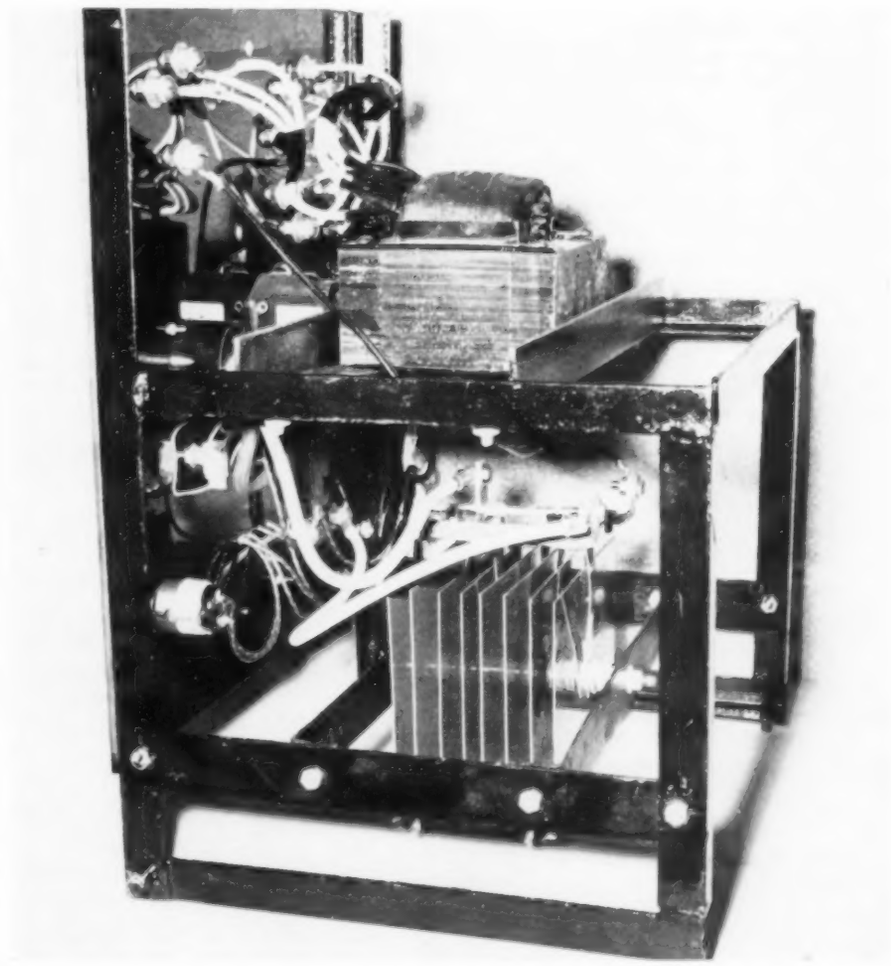

FIGURE 7—Open view of rectifier points up good design features that permit dissipation of heat during operation and ease of maintenance.

must be of sufficiently heavy gage metal so that they will not warp. In the air cooled unit they should have perforated or expanded metal on the bottom and around the under side of a rain hood top. This will allow complete air circulation and yet be "bug proof."

Oil cooled (oil immersed) type housings should be welded tight to prevent oil leakage, and all wires and cables entering the oil chamber should be sealed. The top should be removable by either bolts or lock hasps, but should be kept tight and gasketed.

Housings should have a good coat of primer and paint which may be baked on, or they may be galvanized. A light color to reflect the sun's rays is preferable.

Check Out Panel Wiring. Air cooled units usually have a plastic panel in the front which holds the transformer tap, meters, switch and AC and DC connections.

All wires and cables connecting the transformer, rectifier stacks and other components should be large enough to handle the current and should be well insulated. Connections may be made by use of pressure fitting lugs, or they may be soldered. It is important that all connections be clean of varnish, wax or oxidation products because a large amount of current can easily cause overheating at a high resistance connection.

A thermal or magnetic type switch is usually mounted on the panel; it also serves as a protective device to guard against an overload. Generally an external fused disconnect switch is provided ahead of the overload switch to protect against a direct short.

Meter Pointers. A voltmeter and ammeter are desirable on the rectifier but are not absolutely necessary. A number of types of meters are available. Even a good meter may have a 3 to 5 percent error on full scale.

Meters may be connected directly in the circuit and operate continuously or have the push-to-read feature. On the latter types a switch is used to activate the meter only when a reading is desired. Meters should be rated about one-third greater than their expected maximum operation for best accuracy and readability. —**The End**

If Oil Could Speak

If oil could speak it would have many fascinating truths to tell the non-oil public—truths that would win thousands of new friends for the oil industry.

But, oil can't speak—you can. You, as an individual, can win many new friends for the oil industry if you will pass the true facts on to your non-oil industry friends.

Here are some of those true facts. They are being presented for one purpose: To keep you posted on your industry, so you can tell the story oil is unable to relate.

Read these facts. You will find them informative—and interesting.

"If Oil Could Speak" it would tell the American public:

- In 1956, the oil industry invested $3.6 billion in exploration and production—an all time high. The increased cost is reflected in the fact that in 1938 the industry developed 34 barrels of oil for every foot of hole drilled—in 1945, 20 barrels per foot were developed—and in 1955, less than 13 barrels per foot were developed.

—•—

- In the U. S. we consume 815 gallons of oil products per person per year. The Soviets appear to consume about 100 gallons per person per year. They have little motor transport. Most of their oil goes for industry and defense. China, with a population of 580 million, seems to get by on a petroleum consumption of one gallon per person per year.

  That the U. S. public has such a tremendous advantage over people in other parts of the world can be attributed to one thing—an oil industry allowed to compete in an atmosphere of free enterprise.

—•—

- That tax provisions have accomplished well their purpose of stimulating the search for oil is clearly illustrated in the growth of U. S. reserves. In 1925 crude reserves totaled only 7.5 billion barrels—in 1955 reserves totaled 29.6 billion barrels. And this was accomplished despite a phenomenal growth in demand.

—•—

- No one knows for sure the ultimate discovery potential in the U. S. However, one estimate in 1948 fixed the amount yet to be discovered at 54 billion barrels. If that were correct, the discoverable amount is now down to less than 40 billion barrels, due to discoveries since 1948.

—•—

- Every incentive must be given for the oil industry to develop new reserves. Reason: The ratio of proved reserves to annual production for the past 30 years has been averaging about 12.5. If we assume such a ratio is comfortable, then we must have proved reserves of about 62.5 billion barrels by 1975 (compared with 29.6 billion barrels Jan. 1, 1955). It will be necessary to have new discoveries and developments amounting to about 5 billion barrels per year on the average for the next two decades just to be as relatively well off as we are right now. Yet the largest amount ever produced from new discoveries and new developments in any one year was 5.138 billion barrels in 1951.

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Remember: Oil can't speak—you can. Only you can give the non-oil public the true facts about your oil industry.

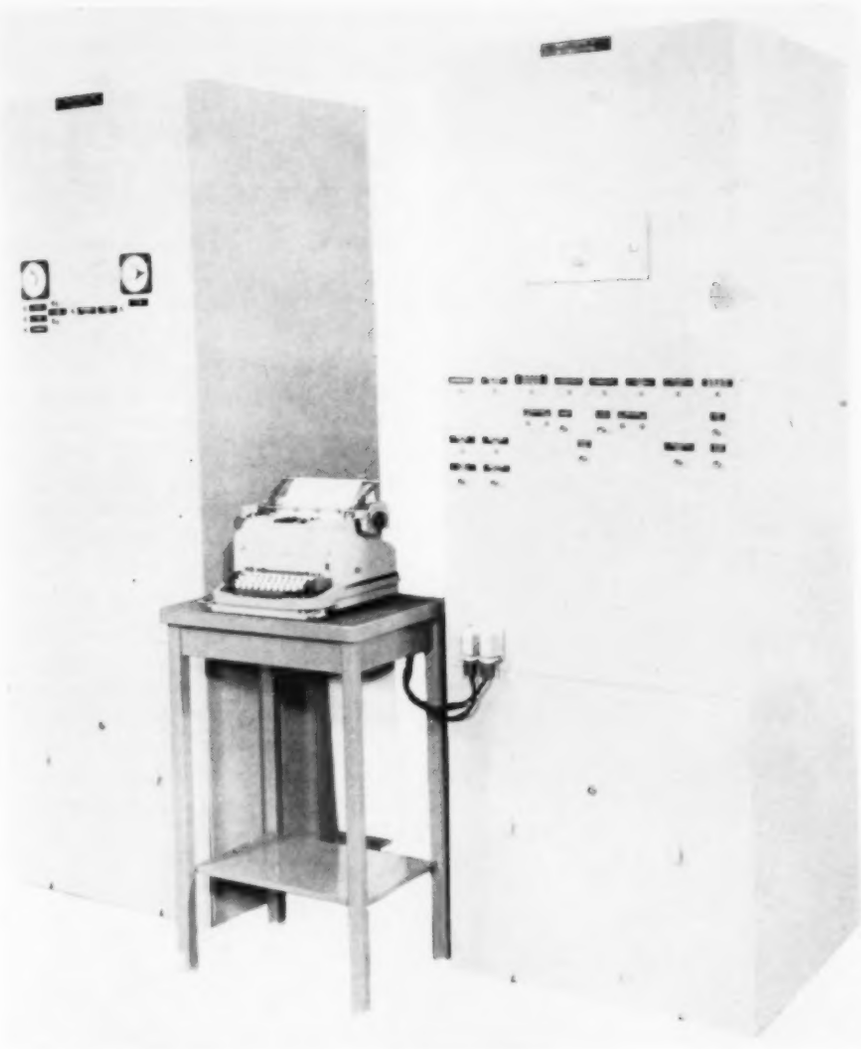


FIGURE 1—Compact design features are shown in this control equipment; the cabinet is located at the satellite station, the typewriter and control cabinet at controlling station.

Digital Telemetering Proves Accurate and Reliable

Service Pipe Line Company developed some new pipe line engineering ideas to transmit operating data and supervisory signals. Satellite station operation proves dependability of system.

By **MAX T. NIGH,**
Service Pipe Line Company
Tulsa

TODAY'S TREND toward closed system pipe lines and remote control has brought many new improvements in the pipe line industry. However, with these innovations have come problems. Remote operation of pipe line machinery necessitates bringing a great deal of information to a controlling point from the "satellite" stations. Transmission and display of this information for best utilization is a subject of interest to all pipe line engineers.

This new method of telemetering used by Service Pipe Line Company makes use of supervisory or centralized control equipment. Digital telemetering offers considerable promise in terms of accuracy, reliability of data transmission, minimum communications channel requirements, and ease of utilization of data in retransmission or computation.

Development. In the past, the most common means of telemetering pipe line information has been the time-impulse method. This involves keying a narrow communication channel for a length of time proportional to the amount of the measured variable. On and off time periods are complements of each other and establish a definite proportional position of a pointer at the dispatching station.

Another such system varies the frequency of a signal imposed on the communication channel proportional to the measured variable. These methods, in effect are, analog methods as compared to digital methods of transmission.

To better define the terms "analog" and "digital" we may compare a slide rule, which is an analog machine, to a calculator, which, in effect, is a digital or coding machine. The slide rule is approximate—the calculator is exact within the limits of its structure.

Service Pipe Line's centralized control system is essentially a digital system.

With the analog telemetering system, the accuracy of readings is dependent upon the uninterrupted pulsing of a communication channel. Noise and signal interruption of any communication system, be it microwave or wire line, will contribute to inaccuracies in the measured result at the dispatch point. This may result in "wiping" or oscillation of the pen on an analog telemetering recorder. This instability, even though recog-

nized, gives concern to the dispatcher in observing changes in the measured variables.

This is in contrast to the security against false registry of information designed into a centralized control system which transmits the supervisory indications in some form of code steps. Data indication can be secured by any of the well known methods such as use of redundancy, three-out-of-five check or message totalizing. If incorrectly received, the system can be arranged to drop out the data before registry and ask for a repeat until the data is obtained correctly. Experience has shown that this security of data against transmission error is very important in a pipe line supervisory control system. A review of principles involved in supervisory systems have been discussed in more detail previously.[1]

Approaching a supervisory or centralized control system to increase its work load for telemetering, necessitates consideration of the duty time in pipe line operations. Scheduling of oil movements in pipe lines is usually made on a weekly or monthly basis so most machinery operations are made fairly rigid for a like period. This is true whether the machinery is locally or remotely controlled.

A corollary of this might be, that the machinery has very few breakdowns or losses of power during such periods, if properly engineered and maintained, and therefore few stops and starts are made. It follows that a standard supervisory control system in pipe line service gets very little use compared with its capacity for work. It is easy to see the incentive to make better use of this exceptional tool of supervisory control. Service system equipment is designed to use supervisory control equipment for telemetering as well as for remote control.

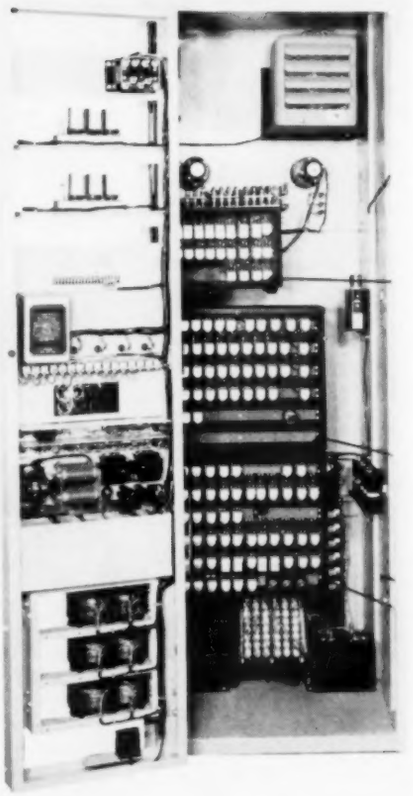


FIGURE 2—Open-back view of control cabinet at satellite station. Programming timer and channel deriving units are on swinging panel. Inside, from top down, are heater, telemeter transmitters, coding unit, storage and programming relays. Deviation and rate of change relays for discharge pressure and flow are in the bottom box.

Design. Digital telemetering was first applied by Service Pipe Line to a single 1250 horsepower booster station on a 12-inch line connecting two stations with tankage in central Wyoming. This electric-centrifugal station's local facilities and control equipment are considered to be good standard design in the pipe line industry and have been discussed earlier.[2] The communication link is 25 miles of telephone line, with all communication channels for control and supervisory indications above 37 kc frequency.

Centralized control system for the satellite station provided for complete remote operation of the pumping unit. These indications of machinery status are transmitted back to the controlling station:

1. **Pumping unit on.**
2. **Pumping unit off.**
3. **Suction valve open.**
4. **Suction valve closed.**
5. **Main breaker open.**
6. **Low suction pressure.**
7. **Communication circuit failure.**
8. **50 psi station low air pressure warning.**
9. **Pump seal failure or high sump.**
10. **Current unbalance of undervoltage.**
11. **High pump case pressure, or case temperature, or high discharge pressure.**
12. **Pumping unit fault (motor overload, motor bearing, motor winding temperature, motor lube oil pressure, trip battery, low voltage, pump vibration, 20 pounds per square inch air pressure alarm).**

Certain faults were grouped to conserve cost in centralized control equipment and still provide all the necessary information for the most efficient type of operation from the controlling station.

Since early development Service has put in operation a number of stations similar to the "satellite" described here; each uses time-impulse telemetering of suction, case and discharge pressure and flow to the controlling station. With this analog system, six communication channels have been required; one for control codes, one for indication codes, and one each for the four measured variables.

In some of these installations it was necessary to use signal channels above

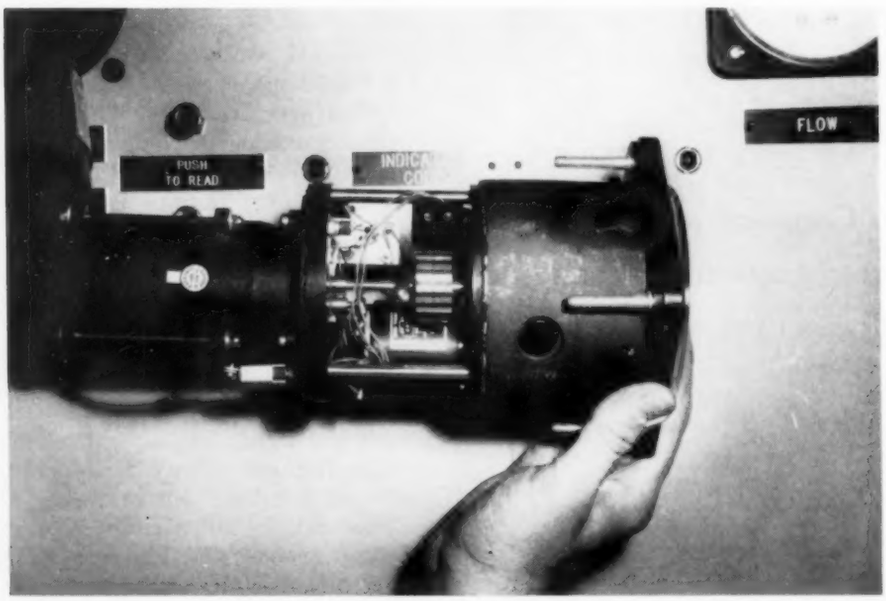


FIGURE 3—Telemeter transmitter is made up of the encoder, servo motor and commutator, and measuring system receiver or indicator shown from left to right.

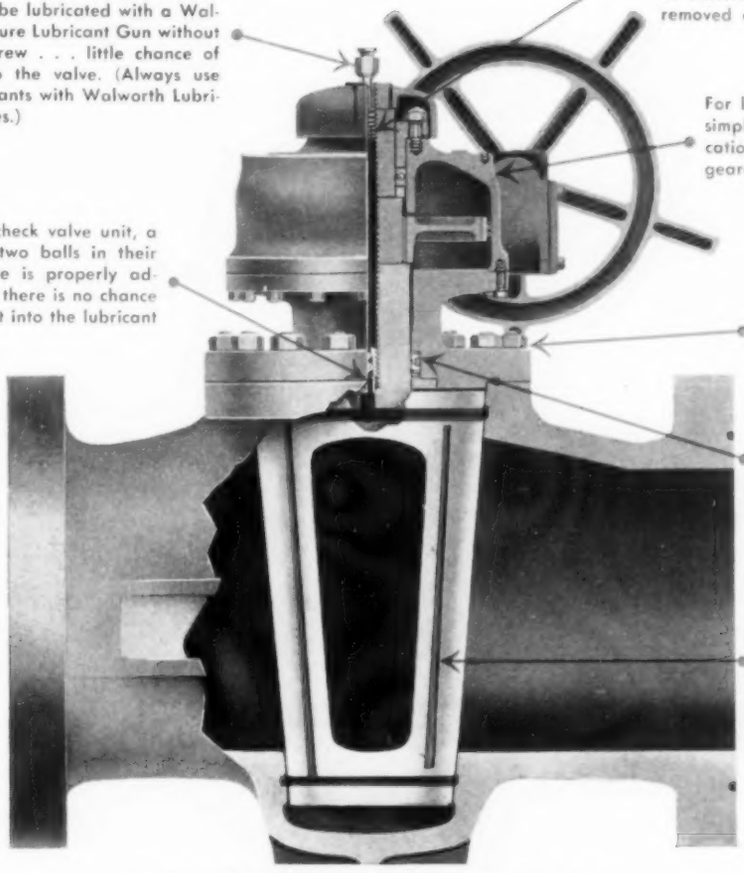
Let's get technical about WALWORTH LUBRICATED PLUG VALVES for pipeline service

Combination button-head lubricant fitting and lubricant screw is provided at no extra cost. Valves can be lubricated with a Walworth High Pressure Lubricant Gun without removing the screw . . . little chance of grit getting into the valve. (Always use Walworth Lubricants with Walworth Lubricated Plug Valves.)

An added safety feature in the form of a groove cut part way up side of the lubricant-fitting screw allows the operator to observe any tendency of lubricant to blow out before the screw is removed entirely.

For buried pipelines — yoke design permits simple attachment of handwheel and lubrication extensions without modifying the gearcase.

In the stainless steel check valve unit, a transverse pin holds two balls in their seats. When the valve is properly adjusted and lubricated, there is no chance for line pressure to get into the lubricant system.



Standard bolt threads, rather than fine threads, mean easy replacement of nuts and bolts from local stocks.

Two overlapping Teflon packing rings form an effective seal against possible leakage without "grabbing" the plug shank. Low breakout torque . . . plug turns easier. Packing serves only as a seal and is not used to hold the plug in its seat.

Lubricant grooves completely frame the port openings and encircle the plug at the top and bottom assuring a tight seal against leaks. Bottom circumferential groove is separate from, but connected with, the lubricant well.

Other Walworth Lubricated Plug Valves include Single Gland and Regular Gland types. Sizes to 30 inches. Pressures to 5000 psi. and for vacuum service.

Cutaway of a 24-inch Walworth Lubricated Plug Valve

Without exception, a Walworth Ball Bearing Lubricated Plug Valve is easier to operate and maintain than any other type of rotary-action, sealed valve available today for pipeline service. Design features pointed out here show just a few advantages of Walworth Ball Bearing Lubricated Plug Valves.

Many pipeline companies throughout the world use Walworth valves for handling gas, crude, and finished products. Investigate the line of Walworth valves for your own needs. See your Walworth Distributor, or write for literature: Walworth Company, General Offices, 60 East 42nd Street, New York 17, N. Y.

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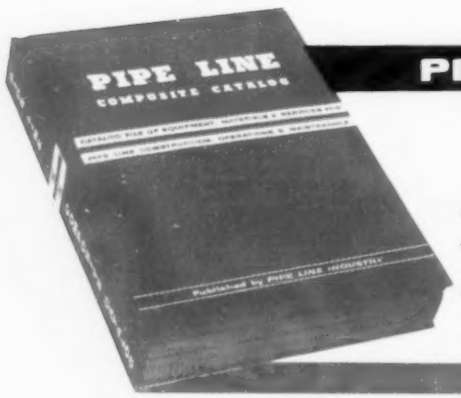

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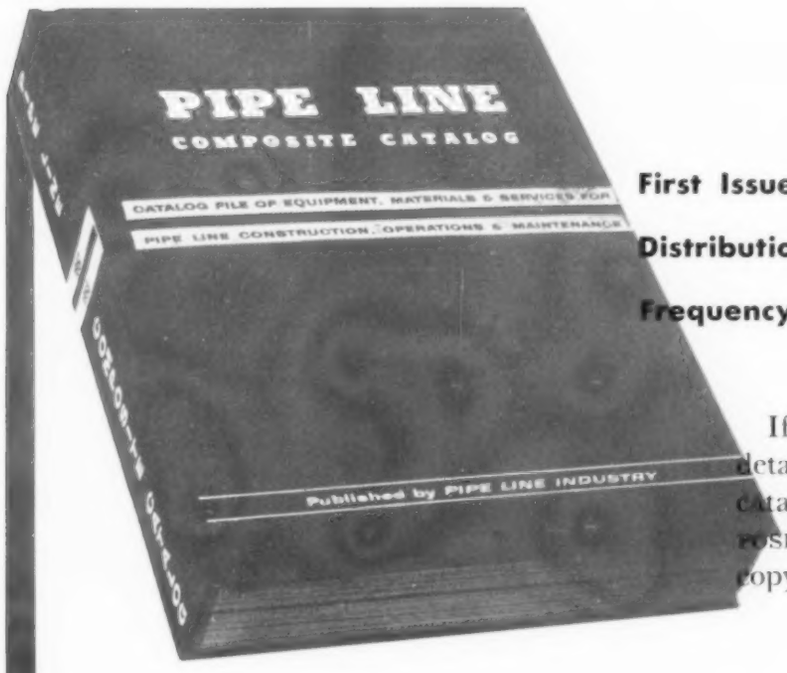
PIPE LINE
COMPOSITE CATALOG
CATALOG FILE OF EQUIPMENT, MATERIALS & SERVICES FOR
PIPE LINE CONSTRUCTION, OPERATIONS & MAINTENANCE
Published by PIPE LINE INDUSTRY

First Issue . . . . . July, 1957

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37 kc to allow for the number of telephone carrier channels occupied by voice communications. This made the requirement for repeaters necessary where any great transmission distance was encountered. When several stations are involved, or where leased wire facilities are the means of communication, the advantage of reducing the number of communication channels is obvious.

By telemetering all the information of the measured variables on the same signal channel used for supervisory indications, the number of communication channels was reduced from 6 to 2.

The programmer at the satellite station transmits each measured variable sequentially. At the controlling station all of these variables are stored and then printed out in sequence on the typewriter along with the time at which the telemetered data was requested. Although only four measured variables are transmitted from the satellite station, a much greater number of measurements could be sent on the same channel with a small increase in the size of the programmer.

Equipment. The control cabinet located at the satellite station, the typewriter and the control cabinet located at the controlling station are shown in Figure 1. Operating features can be seen in Figure 2, which shows the rear of the control cabinet, located at the satellite station. The programming timer and channel deriving units are on the swinging panel. Inside the cabinet from top to bottom, are the heater, telemeter transmitters, coding unit, storage and programming relays. In the bottom box, the deviation and rate of change relays for discharge pressure and flow are shown.

Telemeter transmitters each consist of a pressure measuring system and an encoder. The pressure measuring system consists of a null-balance servo-operated indicator with a differential transformer in the transmitter being positioned by the Bourdon tube or bellows. Each servo motor is driven by the amplified error signal between the differential transformer in the transmitter and the differential transformer in the receiver.

An encoder is a device that converts a shaft position into a digital output, in this case the indicator pointer shaft. This conversion is accomplished by twelve brushes riding on a code plate with alternate silvered and insulated spaces on its surface, establishing a binary code combination. This characterizes the measured variable in digital form.

At the satellite station all measured variables are made up of three significant figures, and thus twelve output circuits are required to supply the binary bits to signify numerical values from 0-999. Four of the bits represent the "thousands" values, four bits represent the "hundred" values, and four bits represent the "tens" values.

Pressure and flow measurements could not be read closer than to the nearest ten pounds and therefore closer values are not transmitted. This is a very important design point. The greatest economy of transmission is obtained when no value is transmitted at a greater resolution than is possible to read at the satellite station. Measurements at the satellite station are made as accurately as possible. Accuracy obtainable with the measuring system is guarded by the code transmission system, and thus the

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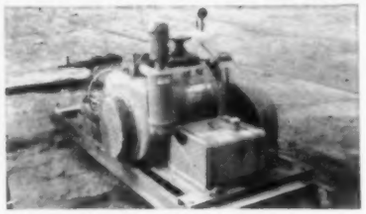

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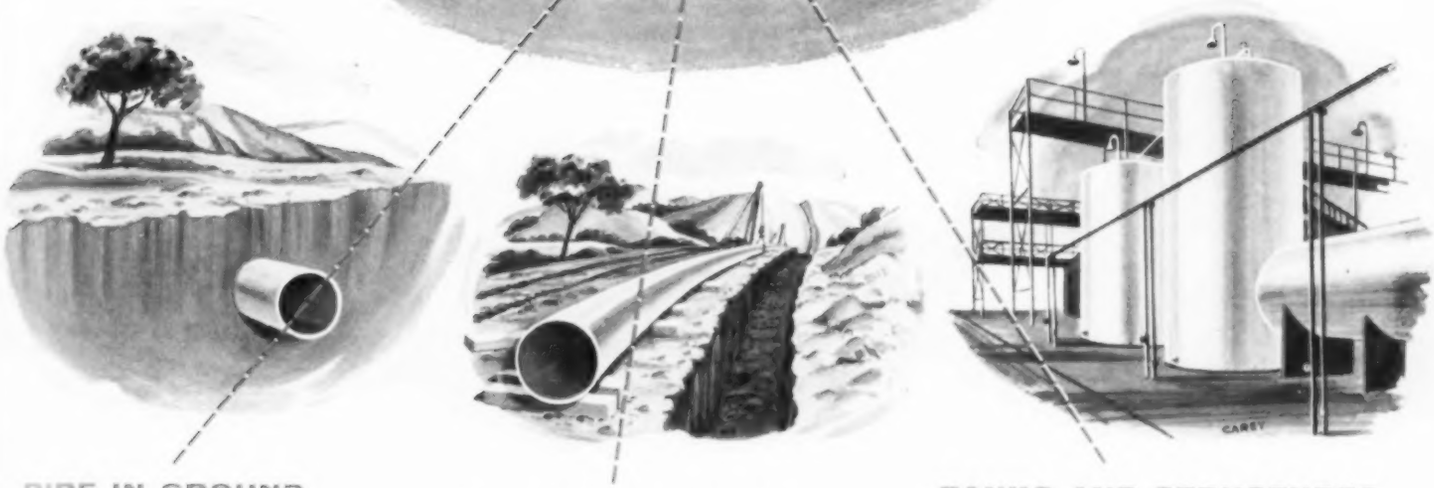

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registry of error is eliminated in the telemetering system.

Figure 3 shows the telemeter transmitter consisting of encoder, servo motor and commutator and the measuring system receiver or indicator. The differential transformer transmitter is not shown nor is the power amplifier for the servo motor. This servo motor receives its power from a magnetic amplifier which measures the error signal between the transmitter transformer and the receiver transformer. Industry in general is showing considerable interest in instrumentation of this type. It offers features which conventional air or electronic instrumentation do not possess; null balance design with sufficient power output to operate a number of devices and a circuit with no vacuum tubes. A code plate is the most convenient method of obtaining output from a shaft position, and an instrument with power output is used to position the encoder.

Transmission of digital data is accomplished in the same manner as all supervisory indications. The measured variable, through the encoder is stored in 12 relay positions in the supervisory cabinet at the satellite station. These relay positions are transmitted as long and short pulses to characterize their position and at the office or controlling station, pulses determine the position that certain relays, designated as storage, are to assume. When the code is received into the controlling station it is stored in weighted decimal binary form. This means that the four bits which represent each digit are assigned weighted values such as 1, 2, 4 and 8. Various combinations of these four digits can determine any number between 1 and 10. A programmer now sweeps past this data in storage and thus determines which keys to operate on the typewriter. A typical print-out record for the starting of a pipe line booster station is shown in Table 1.

TABLE 1
Typical Print-Out Record of Relay Station Starting

20:55	S 610	C 610	D 610	F 1940
21:10	S 610	C 610	D 610	F 1940
21:25	S 610	C 610	D 610	F 1940
21:40	S 610	C 610	D 610	F 1940
21:55	S 610	C 610	D 610	F 1950
***22:06**	**S 570**	**C 940**	**D 620**	**F 1970**
***22:07**	**S 450**	**C 720**	**D 680**	**F 2180**
22:08	S 310	C 670	D 670	F 2300
22:09	S 250	C 650	D 650	F 2210
22:10	S 200	C 640	D 640	F 2140
22:13	S 150	C 630	D 620	F 2050
22:14	S 150	C 650	D 620	F 1990
22:15	S 160	C 650	D 610	F 1980
22:16	S 160	C 650	D 620	F 1980
22:31	S 160	C 660	D 620	F 1970
22:47	S 160	C 660	D 620	F 1970
23:02	S 160	C 660	D 620	F 1960
23:16	S 160	C 650	D 620	F 1960
23:31	S 160	C 650	D 620	F 1960
23:47	S 160	C 650	D 620	F 1960

* These lines are actually printed in red, but here are shown in **bold face** type.

DEVIATION SETTINGS	RATE OF CHANGE
Flow 80 bph	Flow 70 bph per minute with 40 bph threshold.
Pressure 50 psi	Pressure 25 psi per minute with 20 psi threshold.

Four methods are used to set the frequency of sending this information back to the controlling station:

1. An adjustable timer (0-60 min.) in the satellite station cabinet.
2. Dispatcher at the controlling station asks for information by pushing a button.
3. A counting circuit measures the deviation from the previous reading (this is adjustable from 40-100 psi).
4. A rate-of-change, device which not only sends in the telemetered data but asks the typewriter to print the data in red as long as the upset continued and then in black for every minute for five minutes after the upset ceased.

Time is also recorded digitally a

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the controlling station and is printed on the typewriter at the start of each line of data. The interval between requesting data and obtaining a full line of information is approximately 20-30 seconds.

Special Features. As mentioned previously the controlling station can request information, or a timer can automatically send in the information periodically. Another device at the satellite station can initiate the transmission of operating information. Our "silent dispatcher" is applied to the two measured variables, discharge pressure and flow rate. Monitoring equipment is of the computer type, and consists of relays and a commutator with brushes. Transducer for it is the incremental coder or commutator.

Each bar represents 10 barrels per hour or 10 pounds per square inch, change in flow or discharge pressure. The computer receives its intelligence from four brushes (two are common) riding on this commutator. Relays count each 2.5 unit change from the previous reading used as a reference point, and with deviations either up-scale or down-scale, this device adds the units of deviation into the counter. The counter adds in units of 10. As the measured variable reverses itself and starts to return toward the reference point, this device subtracts the units of deviation from the counter.

Thus, the ordinary small fluctuating conditions which are quite natural in pipe line operations never rack up sufficient count to initiate a print-out request. However, when the deviation continues in the same direction and adds up to the given pre-set amount (adjustable from 40 to 100 psi or barrels per hour, in 10 unit increments) this device recognizes the excessive deviation and sends a complete set of telemetered data to the controlling station. Having reported a set of data, a new reference point is established, from which new deviations are monitored.

Another part of this computer is a rate-of-change unit consisting of a timing device to sense whether these deviations occur at a slow or fast rate. In batching operations large amounts of deviation may be expected but the rate will be very slow.

However, rapid deviation may result from an "upset" in the system

About the Author

MAX T. NIGH, who has worked in various phases of engineering pipe line design for the past six years, presently is senior engineer in the electrical section of the Engineering department for Service Pipe Line Company. His activities are in the fields of supervisory control, telemetering and pipe line instrumentation, engineering design and field installation. A graduate of the University of Nebraska, Nigh was a process development engineer in the Petroleum Chemicals Division of California Research Corporation before joining Service.

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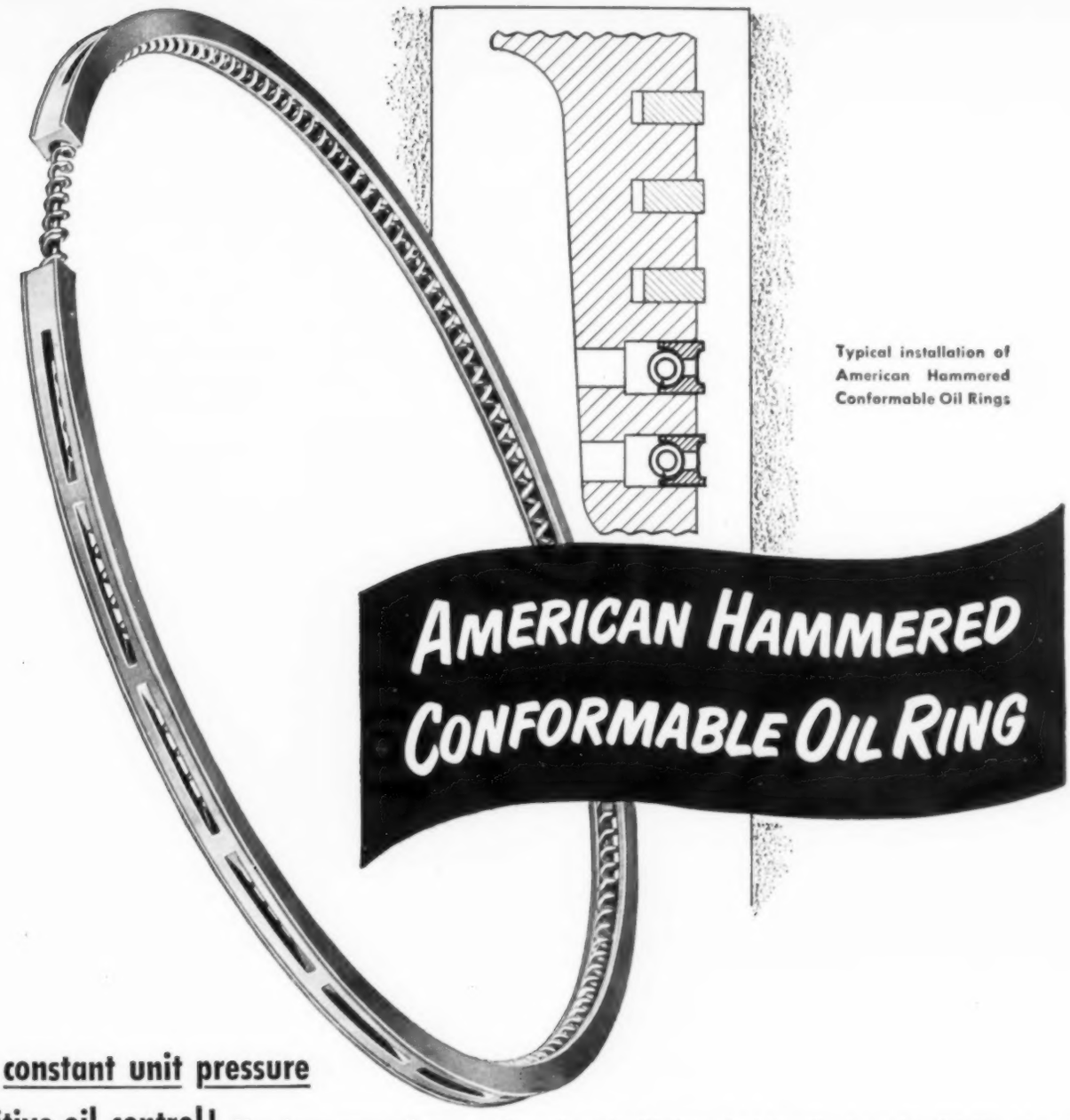

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(i.e. such as a line break or a gate change at the receiving point) and should be reported immediately. The alarm signal is adjustable from 1 bph or 1 psi per minute to 30 bph or 30 psi per minute rate-of-change. A threshold deviation of 20 bph or 20 psi must be obtained before the rate of change will cause an alarm. This device initiates the transmission of a complete set of data to the controlling station. The typewriter prints the data in red and an alarm sounds to direct the operator's attention to the upset. Additional printing of data in black is sent in every minute for five minutes after the upset ceases to establish the new operating condition.

A significant point about the "silent dispatcher" concept is that a "key" measured variable is being monitored continuously. The dispatcher at the controlling station can look at the last line of data printed and know that the operating conditions at the satellite station have not changed appreciably since the time it was printed, providing the communication circuit is intact. Monitoring of the communication channel is usually a standard feature of supervisory control systems. The need for continuous readings or constant observation on the part of dispatcher are eliminated.

A deviation type device is necessary in pipe line operations where batching of crudes of different viscosity and variation in flow rates are constantly changing the operating pressures. A pressure switch set to operate close to the normal discharge pressure could approximate the action of the deviation device if, and only if, conditions never changed. Most pipe line operations are certainly not this constant.

Future System Application. These techniques represent a solution to many of the monitoring problems attendant, with single or multiple pipe line operation, involving a number of satellite stations where batching of crudes is practiced, and where varying rates of flow are encountered. Principles discussed here are being applied to other multiple stations remote operation on Service Pipe Line Company's system.

When the number of variables to be used in pipe line monitoring reach 12 to 60, the transmission of this much data and the method of displaying the information for dispatching use is quite a problem. The digital type display is most easily assimilated by the dispatcher and certainly makes his task much easier.

On systems which are being installed on our pipe line system involving multiple stations a teletype code output is also provided at the controlling station to permit retransmission of the data to a central point and can be used in programming into a computer when desired.

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[1] P. K. Eckhardt's, "Time Code Control and Data Handling Systems," Petroleum Engineer, August, 1956, pp. D-29 and D-32.

[2] L. E. Anderson's, "Midget Booster Stations Doing Big Job," Pipe Line Industry, August, 1956, Vol. 5, No. 2, pp. 46-49.

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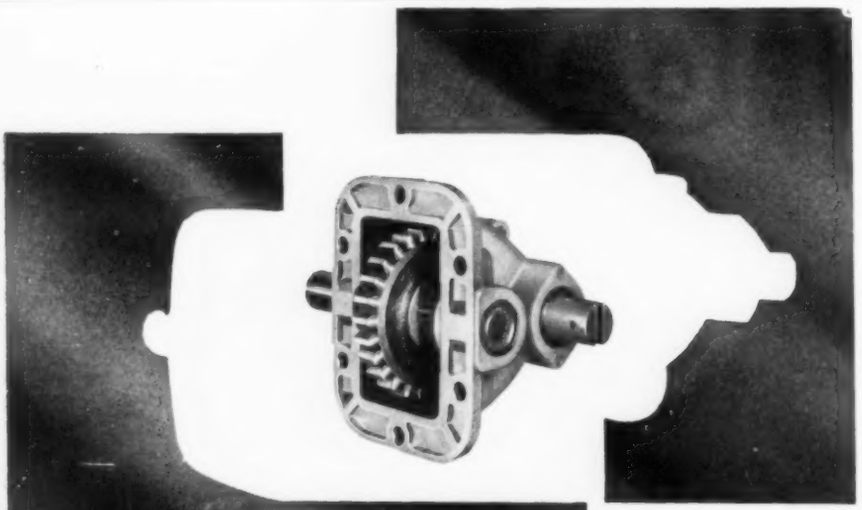

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Are You a Good Supervisor?

Here is a summary of 28 standards management uses to select supervisors and department heads. Check them and see how you stack up.

So THERE'S a new supervisor or department head post coming up in the company and a dozen candidates to choose from. What shall you look for in each to make certain the best possible man is selected?

Securing the best individual is always important; hit and miss selection nearly always overlooks the man who has most to contribute to the job.

Many executives are well aware of this. They have, through experience and counsel, devised definite standards to guide them in selecting supervisors and department heads regardless of the level of the position. From a summary of these time proven and tested selection factors, here is a list of qualities management looks for when selecting supervisory personnel in both the large and the small business.

Absolute Company Loyalty. No individual can deliver maximum efficiency without full and complete loyalty to the firm for which he works. It should rank topmost on any executive's list.

Cooperativeness. There was a day when the ability to give and take, to work smoothly with others and to practice cooperation in getting things done were unnecessary in a supervisor or foreman. Those days are gone forever. To secure maximum results with least effort the good supervisor today must have the ability to take as well as give orders.

Popularity. People follow such an individual because they like that person. This makes supervision much easier than where it has to be forced because of the lack of such personal popularity.

Ability to Get Along With Higher Ups. Good supervision calls for not only handling the men and women working under a person, but to coordinate their efforts with executives. Wherever supervisory personnel possesses this trait there is always a smooth flow of planning from the very top of the company all the way down.

Sociability. Getting along with others is a natural instinct some people possess and others do not. Where it is present in an individual he is always better fitted to size up situations quickly, not only as they affect the job to be done, but as they affect the people who are to carry out the details of each assignment.

Works Harder and Longer Than Others. The man who does only what is required to hold onto the present job seldom has the makings of a good supervisor, even in a modest spot. The one who works harder and longer than others can always be depended upon to exercise the same qualities in a supervisory position.

"Works harder and longer than others"

Judgment. This is a most important factor in selection of supervisors of any kind or type. It is evident in the common sense one uses in handling the everyday problems of the job one now has. Possessing it is assurance that such a person can render decisions in a supervisory spot without delay.

Verbal Facility. A command of words is important, to some degree, in good supervision. The man who can speak with clarity, put together phrases and sentences so that their meaning will be understandable beyond any doubt is always assured of more accurate compliance from those who carry out the details.

Evidence of Self Education. The employe who has shown positive efforts toward improving his business position in the past can always be depended upon to continue doing so in the future. He is always better prepared to handle a supervisory position.

Aggressiveness. The persistence to see any problem through to its final conclusion is a very necessary quality in any good supervisor. The individual who has shown little sign of aggressiveness in his job to date is very unlikely to show any in the future.

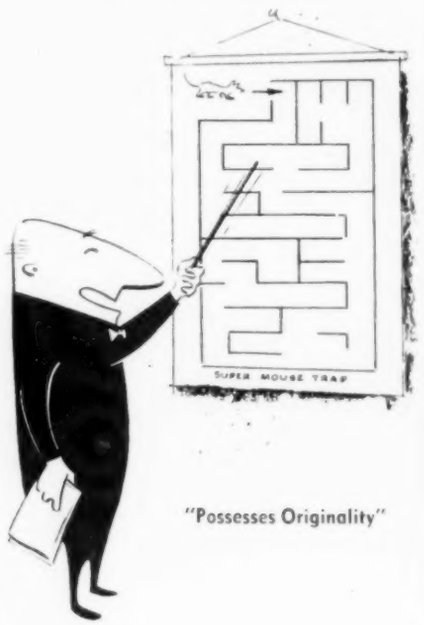
Possesses Friends as Well as Enemies. "He would be an excellent man —everyone likes him—hasn't a single enemy in the world," is a very nice

compliment to pay any individual under consideration. However, the man who gets things done is seldom able to do so without making enemies at one time or another. Too many of the latter, of course, is a sign of weakness. Our candidate will seldom be without them if he possesses the qualities which make for good supervisory personnel.

Humor. The good supervisor is never a wise-cracking, joke-telling personality; but he should definitely possess a good sense of humor. It relieves tense situations which he will have to handle.

Experience. Experience in the field or in the job can never be left off any such check no matter how many other fine qualities the candidate may possess. Without it the firm must wait patiently while that experience is acquired and that can be a long drawn out and very costly procedure.

Lack of Prejudices. This is a world loaded with prejudices of all kinds manner and shape. The good supervisor has to work with all of them He can never get the most out of the men on the staff when held back by fixed prejudices with regard to race creed, religion or anything else.



"Possesses Originality"

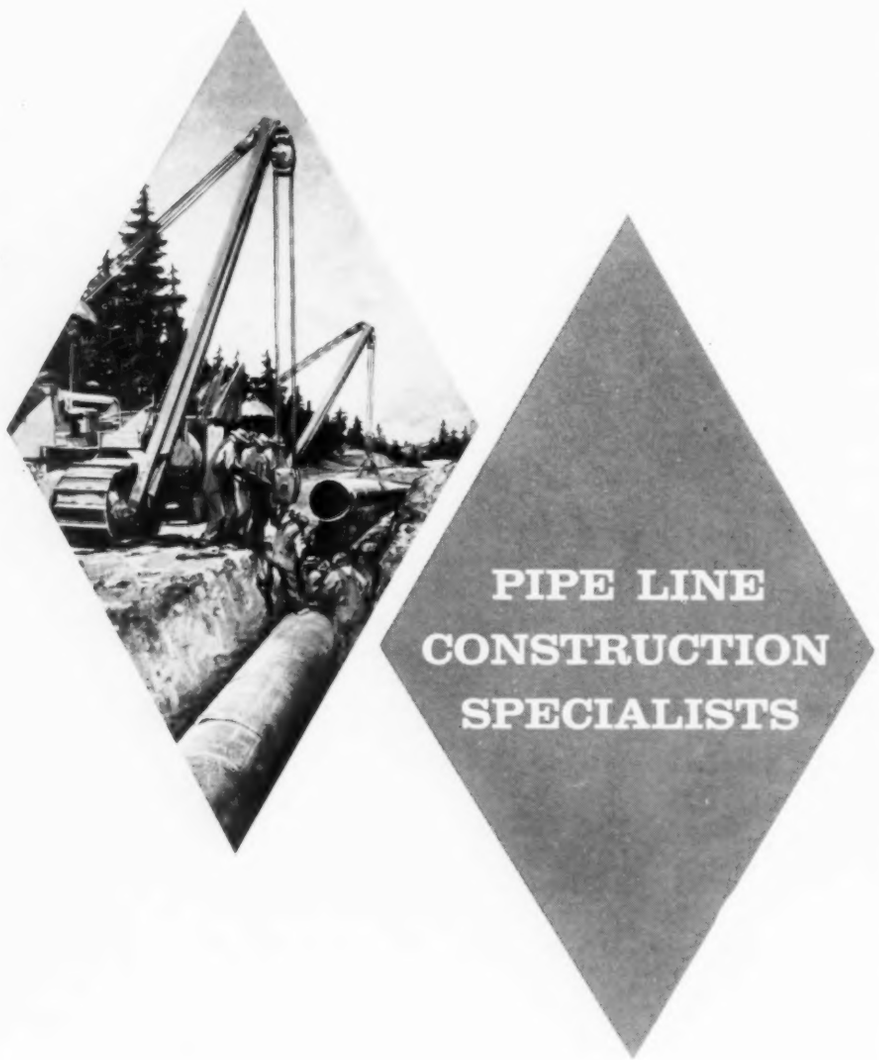
Originality. This valuable quality enables one to figure out the best way to do things and not to proceed chiefly on a basis of imitation or to supervise solely on a program of following precedent. It assures the ability to come up with the idea that sets patterns rather than follows them.

Liveliness. This demonstrated quality means that a candidate for supervisory position will work hard and play better along with having the energy and vitality to handle the toughest and most exacting assignments in the future.

Knows His Job. That's always a good check on quality of an individual. We can never expect performance in a new post from the man who has failed to conquer the problems of his present position. He will show the lack of ability to do so in the new post given him every time.

Desire to Excel. This is most important in good supervisors. It determines the quality of job performance every time. It is demonstrated by the goals the individual seeks. It is shown in how his aspirations give the drive needed to get the job done.

Self Confidence. It helps a supervisor make up his mind decisively and

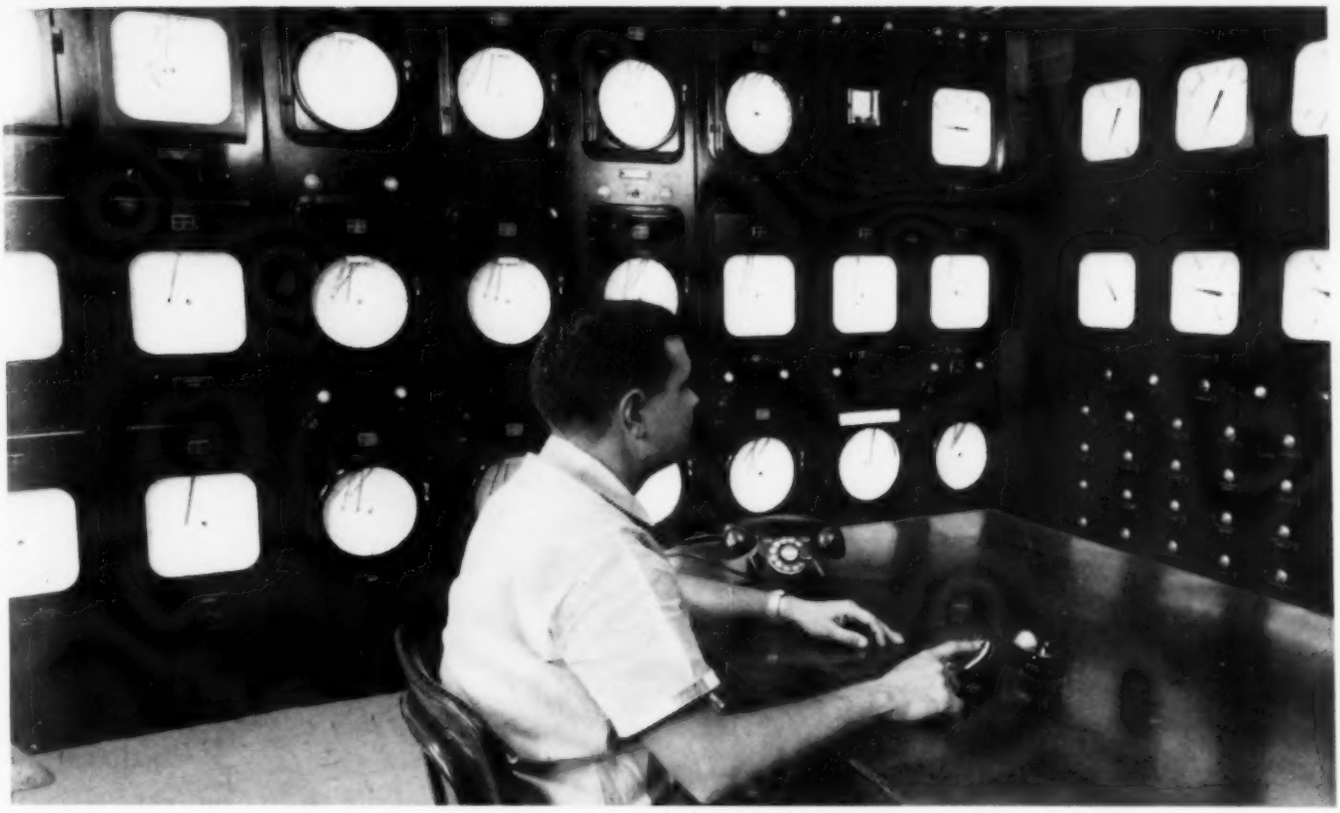


Houston
CONTRACTING COMPANY
GENERAL CONTRACTORS
Laurence H. Favrot • R. P. Gregory • Geo. A. Peterkin

OIL • GAS
GASOLINE
WATER PIPE LINES

2707 FERNDALE
HOUSTON 6, TEXAS

For more data on advertised products, use Readers' Service Cards, last page.



Bell System *selective calling* is used by the dispatcher of Mississippi Valley Gas Co. By flipping a switch, dialing the number of a distant metering point and reading a meter, he knows the pressure, flow and temperature at any of the company's 21 field points.

"When you're sure how much you have, you know how much you can sell"

J. H. Lambdin, Vice President—Operations, Mississippi Valley Gas Company

Bell System telemetering channels provide data on which Mississippi Valley Gas Co. can regulate flow to within 1% of a 60,000 MCF supplier contract limit. With this up-to-the-minute picture of the system, the company is better able to sell more gas.

This system, first of its kind in the country, was designed especially for Mississippi Valley. Used only to read remote meters now, it can be adapted to perform actual control functions at distant points.

• • •

If you'd like to have faster, more efficient communications, call your Bell Telephone representative. He will be glad to study your needs.

BELL TELEPHONE SYSTEM

PRIVATE LINE TELEPHONE • PRIVATE LINE TELETYPEWRITER

CHANNELS FOR: DATA TRANSMISSION • TELEMETERING • REMOTE CONTROL
TELEPHOTOGRAPH • CLOSED CIRCUIT TV

For more data on advertised products, use Readers' Service Cards, last page.

TD-24 Sideboom spots twisted pipe with

precision control
inch-close accuracy!

Have a close look at the gulch-crossing, grade-climbing course this new Pacific Gas and Electric Company line takes in Jackass Pass near Mendota, California—on a section being laid by Midwestern Constructors, Inc., Tulsa, Oklahoma. Then you'll appreciate the special TD-24 spread-speeding, pipe-handling precision that earns high praise from the boss:

Earl R. Wolfe, pipe-lowering and tie-in foreman on the spread, reports: "With the International Superior TD-24 side-boom tractors I've been able to fit twisted pipe into the ditch many times without cutting. And that means in places where with other tractors, the pipe would have had to be cut. My welders have it easy. I don't known of any other side-boom equipment that could handle the 34-inch pipe on this mountain operation so well."

Control Begins with Planet Power steering!

This twisted-pipe-spotting, precision handling control begins with exclusive International TD-24 Planet Power steering. You can feed full-time live power to both tracks smoothly and steadily—to turn as sharply or gradually as desired—without eccentric, jerky travel even with heavily-loaded boom!

Exclusive TD-24 finger-tip hydraulic braking and foot decelerator help give positive pipe-carrying control by exact regulation of tractor motion. And with minimum operator effort, from reach-easy control lever clusters, the International Superior TD-24 gives you amazing *response* speed, and *inch-close* accuracy of boom action control!

Get on-the-line proof of the big, exclusive International Superior TD-24 precision, spread-speeding advantages. Compare new bonus-powered TD-18, TD-14, and TD-9 side-booms to any other units in their size classes. See your International Construction Equipment Distributor for a demonstration of the boom and tow equipment you need!

Grades on this mountainous section of new 34-inch P.G. & E. gas line ranged from 37% to 57%. Yet time and again, the boom team saved vital, weather-beating hours—using outstanding International Superior TD-24 side-boom precision control to lay twisted pipe without cutting! Picture shows Midwestern's TD-24 side-booms working as a team!

INTERNATIONAL®

SUPERIOR®

International Harvester Co., 180 N. Michigan Avenue, Chicago 1, Illinois

A COMPLETE POWER PACKAGE INCLUDING: Crawler, Wheel, and Side-Boom Tractors ... Self-Propelled Scrapers and Bottom-Dumps ... Crawler and Rubber-Tired Loaders ... Off-Highway Trucks ... Diesel and Carbureted Engines ... Motor Trucks

promptly. It inspires the same quality in those who must carry out details of the assigned task. Its lack means weakness and loss of respect from the staff.

A Degree of Success in Personal Life. The man with a mixed up personal life seldom achieves any degree of success in even the most minor supervisory role. Those of us who cannot solve our personal life problems seldom possess the ability to solve the more difficult business problems which are a part of such positions.

"Enjoys a degree of success in personal life"

Good Health. When other qualities are equal between given candidates this is always a good one upon which to make the specific decision. The individual in possession of good health and who works at keeping it can always be depended upon to have the physical equipment required of supervisory position in the future.

Seldom Reverses Decisions. Results in any given firm come when supervisors are sure of their orders and plans, and members of the staff know that they will be followed through. Overhead costs rise when the staff can never be sure a given supervisory decision will stand and not be changed tomorrow.

Age. The smoothest running departments have always been those in which supervisors are older than the men and women working therein. It's a human trait to respect those who are older.

Ability to Explain. Many of us can give orders but at the same time, adequately explaining the reasons behind those orders is not always a quality we possess. The supervisor who can do so is always assured maximum results will be obtained from every assignment.

Intelligence. Above average intelligence is always a quality to check in any candidate for a supervisory position. It is also wise to guard against selecting an individual with intelligence far above that needed for the job.

High Frustration Tolerance. An absolute requirement for a good supervisor. Even temperament is basic requirement of the job. The man who can tolerate nothing but perfection all of the time seldom attains the overall results desired by any progressive business firm.

Appearance. Good supervisors do not have to be movie stars in appearance, but they must be the type of people who give attention to their personal grooming. It inspires respect from others.

Emotional Balance. Possession of this quality is always to be desired in any supervisory personnel. The man who can win without exalting and lose without moping always has a smoother functioning department.

—The Ed

HE'S THE MAN who helps your pipe coating jobs move along smoothly — on schedule. He's there before the kick-off, making sure that enough LION E-120 asphalt coating is on hand, packaged in easy-to-open containers which one man can handle. He checks all equipment, inspects the kettles, adjusts the shoes and makes a careful examination of all surfaces to be coated. He's your HOLCOMBE service engineer.

That's one big reason why company inspectors "OK" the first application of LION E-120—that's why contractors move right along according to schedule — without a hitch.

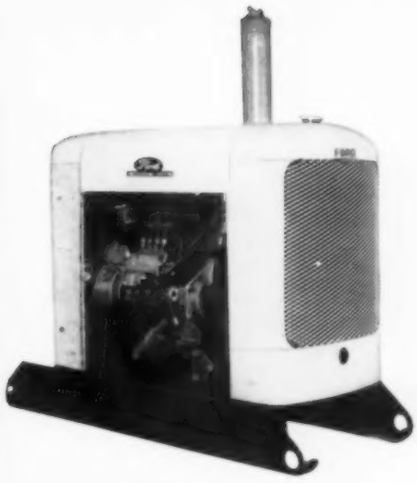
So on your next pipe coating job, no matter how big or how small, let us know in advance. We'll see that you have an experienced HOLCOMBE engineer at the site, well ahead of kick-off time.

Write for complete specifications of LION E-120 *asphalt coating and literature on other* HOLCOMBE *corrosion prevention products.*

THE HOLCOMBE COMPANY, INC.
FIRST NATIONAL BANK BUILDING TELEPHONE 5-3468
SHREVEPORT, LOUISIANA
HOLCOMBE COMPANY OF CANADA, INC.
323 BARKER BUILDING TELEPHONE 6-7291
CALGARY, ALBERTA, CANADA

Lion Coatings • Holcombe Selenium Rectifiers
Pipe Wrappings • Graphite Anodes • Coke Breeze

Announcing
THE
FORD "220" DIESEL
...now available as a complete power unit!



POWER UNIT

Ford
INDUSTRIAL ENGINES AND POWER UNITS

Looking for really *modern* diesel power? Here it is in one complete 4-cylinder, 220-cu. in., skid-mounted power unit.

Modern design throughout makes this Ford diesel outstanding in power and economy. It delivers more actual sustained power at the flywheel than ever before possible in engines of comparable displacement. Exceptionally rugged in construction, it is quality-built throughout for longer life.

Features such as replaceable cylinder sleeves, aluminum pistons and balanced crankshaft, for example, give you peak performance, longer engine life. Overhead-valve efficiency boosts economy, makes servicing easier.

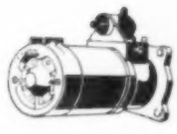
Drop in and see your Ford Industrial Power Dealer for full information on this modern, super-efficient Ford diesel. Or write: Industrial Engine Department, Ford Division of Ford Motor Company, P.O. Box 598, Dearborn, Michigan.

ENGINE ASSEMBLY

WET CYLINDER SLEEVES
Replaceable cylinder sleeves are positively located, yet easily removable—eliminating costly reboring. Synthetic rubber seal ring at bottom of jacket.

FOUR-WAY INJECTOR
Precision made four-way injector disperses diesel fuel evenly into each cylinder for efficient combustion, more power, and greater fuel economy.

ROTATING EXHAUST VALVES
Exhaust valves are free-turn type, designed to rotate each time valve opens and closes. Makes for even wear, helps maintain compression longer.



12-VOLT ELECTRICAL SYSTEM
High-torque 12-volt starting motor provides faster cranking speeds and delivers extra power for quick starts even on the coldest mornings.

YOUR JOB IS WELL-POWERED WHEN IT'S FORD-POWERED!

Rules of Thumb

FOR THE PIPELINER'S NOTEBOOK

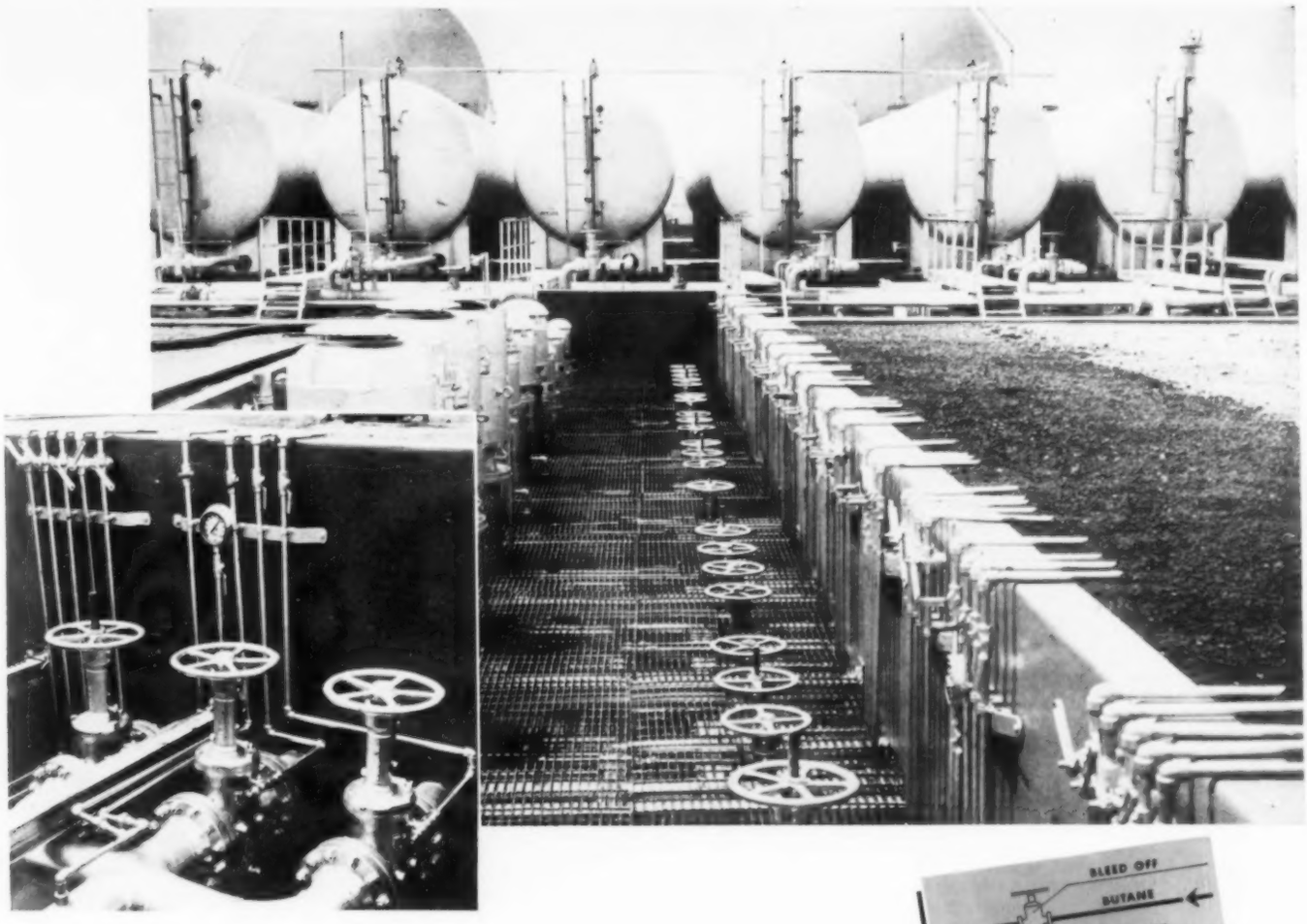
$15 Per Rule of Thumb

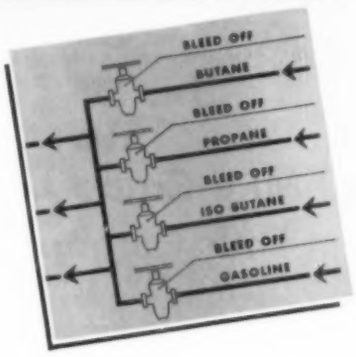
These formulae from the pages of engineers' own notebooks yield rough, but reasonably accurate answers for design, maintenance and supply questions. The Editors will pay $15 for your pet Rule of Thumb. Send your Rule of Thumb to PIPE LINE INDUSTRY, P. O. Box 2608, Houston 1.

Corrosion Protection —15—Approximate pipe coverage with plastic tape.

Nominal Pipe Size	Actual O.D.	Tape Width	Tape Overlap	Squares of Tape Required for 1000 Lineal Feet Pipe (Approx.)	Squares of Tape Required for Mile of Pipe (Approx.)	Approx. Surface Sq. Ft. per Mile
¾"	1.050	2"	½" ⅜"	3.15 3.4	16.6 18.0	1,450
1"	1.315	2"	½" ⅜"	4.0 4.3	20.8 22.7	1,820
1½"	1.900	2" 3"	½" ¼"	6.2 5.43	32.8 28.7	2,630
2"	2.375	2" 4"	⅜" ½"	7.7 7.1	40.7 38.0	3,290
3"	3.500	2" 4"	⅜" ½"	11.3 10.5	60.0 56.0	4,850
4"	4.500	4" 6"	½" ½"	13.5 12.9	71.0 68.0	6,220
5"	5.563	4" 6"	½" ½"	16.7 15.9	88.0 84.0	7,690
6"	6.625	4" 6" 9"	½" ½" ½"	19.9 19.0 18.4	105.0 100.0 93.4	9,160
8"	8.625	6" 8" 9"	½" ½" ½"	24.7 24.1 24.0	130.5 127.3 126.5	11,930
10"	10.75	6" 8" 12"	¾" ¾" ½"	30.7 30.0 29.4	162.1 158.4 155.1	14,860
12"	12.75	6" 8" 12"	¾" ¾" ½"	38.2 36.9 34.9	201.7 194.9 184.0	17,630
14"	14"	8" 12" 15"	¾" ¾" ½"	40.5 39.1 38.0	213.9 208.2 200.3	19,360
16"	16"	8" 12" 15"	¾" ¾" ½"	46.3 44.7 43.4	244.5 236.1 228.9	22,120
18"	18"	12" 15"	¾" ½"	50.3 48.7	265.6 257.5	24,890
20"	20"	12" 15"	¾" ½"	55.9 51.2	295.2 286.1	27,650
22"	22"	12" 15"	¾" ½"	61.5 59.6	324.8 314.7	30,420
24"	24"	12" 15"	¾" ½"	67.0 64.9	353.8 343.3	31,180
26"	26"	12" 15"	¾" ½"	72.7 70.3	383.8 371.8	35,940
28"	28"	12" 15"	¾" ½"	78.2 75.8	412.9 400.5	38,710
30"	30"	12" 15"	¾" ½"	83.8 81.8	442.5 431.8	41,740

To find number of squares in a roll multiply the tape width (inches) by the length in feet, and divide by 1200. **EXAMPLE:** 9" tape, 400 ft. roll. Square $= \frac{9 \times 400}{1200} = 3$ squares/roll. Number of rolls for 1000 feet or mile of pipe may be estimated quickly.





A SINGLE W-K-M VALVE PROVIDES DOUBLE BLOCK AND BLEED PROTECTION

W-K-M non-lubricated gate valves with parallel expanding gates and TEFLON* seats seal vapor-tight on both the upstream and downstream seats, regardless of the direction of pressure. This provides the same protection as two conventional valves in a double block and bleed hookup. As the illustration above shows, the bleed line is attached to the body through a tapped opening, thus making it possible to bleed the body completely while holding securely a different gaseous or liquid product on each side of the valve. In addition, the stem on W-K-M rising stem valves is out of the body—to permit lubrication of the threads for easier opening and closing. The valve stem also serves as an "open"—"closed" indicator.

When you use W-K-M valves in such installations you save from ⅓ to ½ in valve costs and also save in piping and hookup time; in operation there is only one valve to handle instead of two.

Before you plan your next manifold, investigate W-K-M valves. They provide the most economical and efficient means of protecting your products from contamination.

*DUPONT TRADE NAME

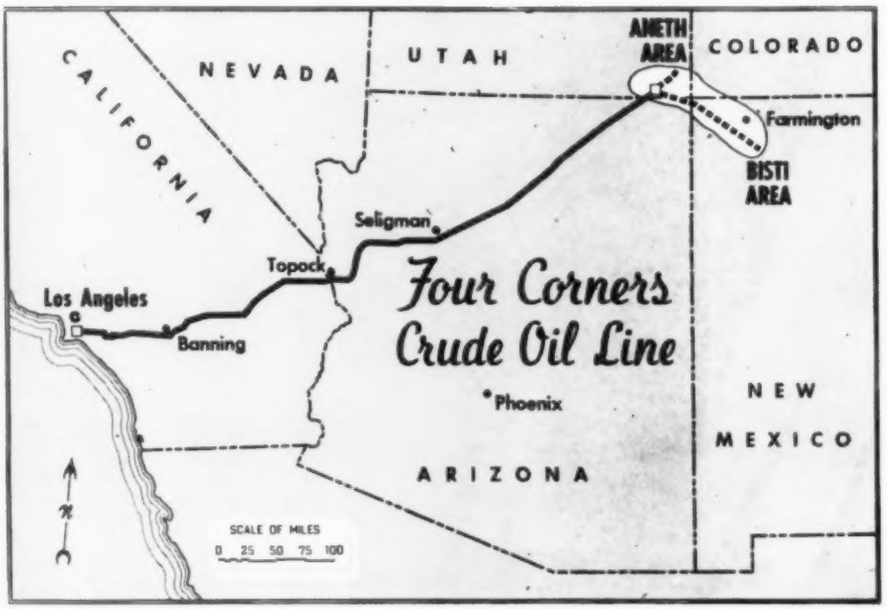
5609

W-K-M
DIVISION OF acf INDUSTRIES INCORPORATED
PLANT: MISSOURI CITY, TEXAS
MAILING ADDRESS: P. O. BOX 2117, HOUSTON, TEXAS

MANUFACTURERS OF

W-K-M	acf	KEY
THROUGH-CONDUIT GATE VALVES	LUBRICATED PLUG VALVES	RETURN BENDS AND FITTINGS

For more data on advertised products, use Readers' Service Cards, last page.



Construction will begin in April on a 600-mile crude oil pipe line from the Four Corners area to Los Angeles.

600-Mile Crude Line System From Four Corners Area Planned

Four Corners Pipe Line Company, a newly-organized firm, has been established to construct a $50 million crude oil line from the Four Corners area to Los Angeles.

The project is the result of plans announced several months ago by Shell Oil Company and Standard Oil Company of California, two of the firms which now hold stock in the new company. (See PIPE LINE INDUSTRY, November 1956, p. 88.) Stock in Four Corners Pipe Line Company is held by Continental Pipe Line Company, 10 percent; Gulf Oil Corporation, 20 percent; Richfield Oil Corporation, 10 percent; Shell Oil Company, 25 percent; Standard Oil Company of California, 25 percent; and Superior Oil Company, 10 percent.

R. G. McIntyre, who retired January 31 as chairman of the board of Standard Oil Company of Texas and as president of Pasotex Pipe Line Company, was elected president of Four Corners Pipe Line.

The proposed line will have an initial capacity of 60,000 barrels per day and ultimately capacity could be increased to 160,000 bpd by increasing pump stations en route. Shell Pipe Line will build and operate the line as agent for the company. Preliminary engineering has been done and pipe delivery is scheduled for April. Crude shipments out of the Four Corners area are expected to begin by the end of 1957.

The complete crude oil line system will total 750 miles, including 8 and 12-inch feeder lines to the Aneth and other fields in Utah and the Bisti field in New Mexico. The 16-inch main trunk line will originate on the Navajo Indian Reservation in the southeast corner of Utah and will terminate at Los Angeles refineries.

Transco Seeks Approval For $61.5 Million Expansion

Transcontinental Gas Pipe Line Corporation has announced plans for construction of $61.5 million of new facilities including gathering laterals and loop lines, new compressor stations, new gathering meter stations, and dehydration stations.

An application for authorization of the project has been filed with the Federal Power Commission. The project is a major part of Transco's $113 million construction program planned for this year.

Transco proposes to build 229 miles of gathering laterals in Texas to bring new gas reserves into the Transco system. Five new gathering meter stations and five dehydration stations are planned. The new application includes 42 additional miles of 36-inch and 16 miles of 30-inch loop lines. Most of the main line looping program for 1957 has been proposed in an application already before the F.P.C.

Included in the application are seven new mainline intermediate compressor stations in Louisiana, Mississippi, Alabama, Georgia, North Carolina and two in Virginia. Additional compressor engines will be installed in nine existing stations.

Transco has pending final approval of a $50.9 million construction program started last fall. Of the 350 miles of large diameter pipe requested in that application, now before the F.P.C., 161 miles were laid last fall and early winter under a temporary certificate, and 12,000 additional horsepower was installed. The remaining phase of construction, including 30 and 36-inch main line loops in nine states, will begin as soon as final authorization is received.

Construction in the new application will result in an increase of daily allocated capacity of 111.4 million cubic feet and increase facilities for delivery of gas to Virginia Electric and Power Company. Transco re-

One-man-operated CLEVELAND 190 backfills pipeline *"almost as fast as man can walk"*

Much of this United Gas pipeline from the Chocolate Bayou field to the main line near Webster, Texas cuts through rice-growing farmlands. To avoid interference with the placement of water canals, the 42-inch wide trench had to be dug extra deep—to an average of approximately 7 feet—forming big heavy spoil banks of wet sticky gumbo in many places. Along much of the 16-mile line, the trench also was filled with underground water which seeped in from the rice fields.

In spite of these adverse conditions, a Cleveland 190 backfiller helped Fowler-Tatom Pipeline Contractors keep the job moving at a good rate, leaving no open trench at the end of any day's work. Working right on the heels of the lower-in crew, the one-man-operated 190 tied down pipe in the water-filled trench, then doubled back and completed the fill and finished it off with a neat clean-up job. The job report states, "The Cleveland 190 backfilled trench almost as fast as a man can walk." Because it never has to leave the right-of-way to do any part of its job, the 190 was also a big factor in getting this job done with no off-right-of-way damage.

BUILT FROM THE GROUND UP TO DO ALL YOUR BACKFILLING...BETTER

One-Man-Operated
79 H.P., 467 Cubic Inch Diesel Engine
Perfect Balance, Low Ground Pressure
4 Backfill Line Speeds
Telescopic Boom, 19′ to 27′
Hydraulic Boom Hoist
Hydraulic Steering Brakes
Hydraulic Backfill Clutches
7′ x 3½′ Backfill Board
All speeds (1 fpm to 4.3 mph) in Either Direction

Good Everywhere ®

THE CLEVELAND TRENCHER COMPANY

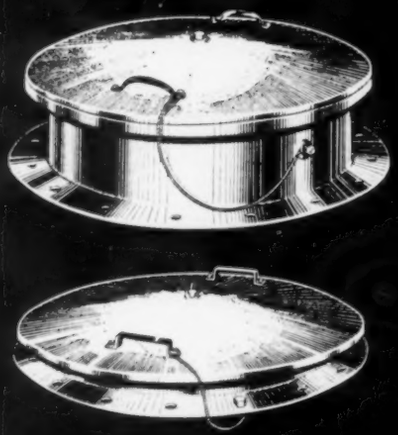
20100 ST. CLAIR AVENUE • CLEVELAND 17, OHIO

For more data on advertised products, use Readers' Service Cards, last page.

"BLUE CHIP" *Investments*

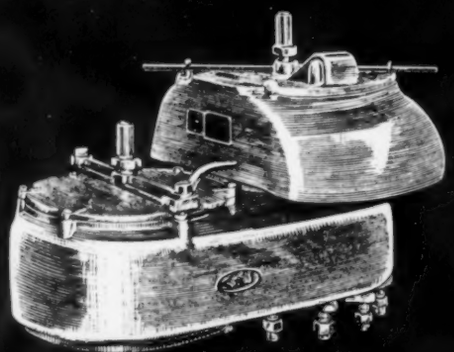
S&J Pilot Operated Safety Relief Valve, Fig. ST-5000, provides positive protection to tanks from overpressure within range from 1 to 10 pounds.

The Shand & Jurs line of Pressure and Relief Valves and equipment for petroleum tanks truly provide extra "dividends" from the air. These conservation fittings deliver substantial savings by reducing evaporation losses, consequent reduction in volume of liquid as well as loss of gravity. There is an S&J Breather Valve or Vent available for almost every tank requirement.

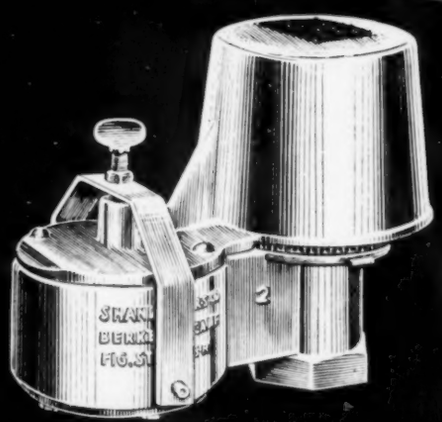


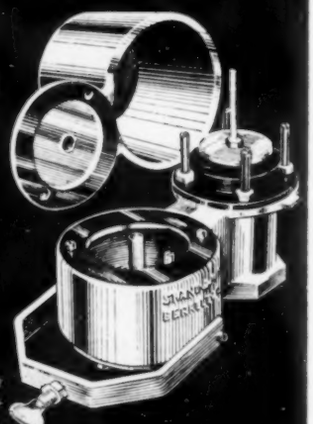
S & J Emergency Vent, Figs. ST-5455 and ST-5455A, provide emergency venting for surges, unusual thermal conditions or over-filling. Fits Standard 20" A.P.I. manholes.

S&J Combination Breather Valve and Gage Hatch, Fig. ST-1615. Economical venting for small marketing and bulk plant tanks.



S&J TITE-SEAL Vapor Saving Breather Valve, Fig. ST-7575, designed for vapor conservation systems provides tightest seal against pressures and vacuums below valve settings.





S&J Breather Valve, Fig. ST-3695R features a one piece vacuum-pressure valve cover for quick accessibility. Available in 2, 3 and 4 inch sizes.

SHAND AND JURS CO.

A SUBSIDIARY OF CPE

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REPRESENTATIVES:
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MONTREAL: Lytle Engineering Specialties, Ltd., 360 Notre Dame St., W.
TORONTO: Lytlo Engineering Specialties, Ltd., 69 Eglinton East
VANCOUVER: P. D. McLaren & Son, Ltd., 3277 Main Street
CALGARY: P. D. McLaren & Son, Ltd., 510 - 9th Ave. W.
MEXICO, D.F.: Dalma Comercial, S. A.
CARACAS: Sinclair Spence, C.A., Edificio Galipan
ENGLAND: Whessoe, Ltd., Sales: 25 Victoria St., London S. W. 1
Whessoe, Ltd., Works: Darlington, County Durham

cently contracted to move daily from Louisiana gas fields to Virginia approximately 25.6 million cubic feet of natural gas for Virginia Electric and Power.

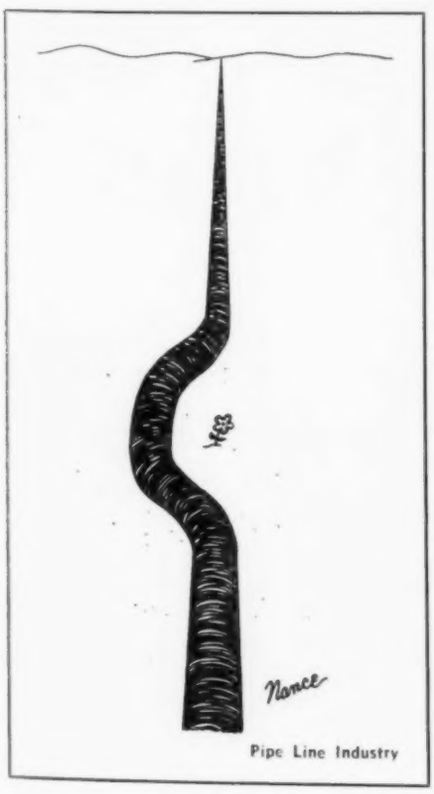
Total expansion of Transco facilities this year, announced by Tom P. Walker, Transco president, will cost in excess of $113 million. By the end of 1957 the daily allocations on the company's system will reach 945 million cubic feet, exclusive of the 136 million already available from storage on cold days to distribution companies in the New York-New Jersey-Philadelphia area.

Work is to begin soon on one of Transco's smaller construction programs, 28 miles of 16-inch lateral in Cameron Parish, La., to take Transco's first offshore gas purchase.

Trans Mountain Plans Expansion of System

Studies are underway for the expansion of the Trans Mountain Oil Pipe Line Company's system to develop the system beyond its present 200,000 barrels daily capacity rate which will be reached by completion of the pumping stations at Jasper and Gainford in 1957.

Plans are underway to increase system capacity to 300,000 barrels daily by a proposed looping program and construction of additional station and tank farm facilities.

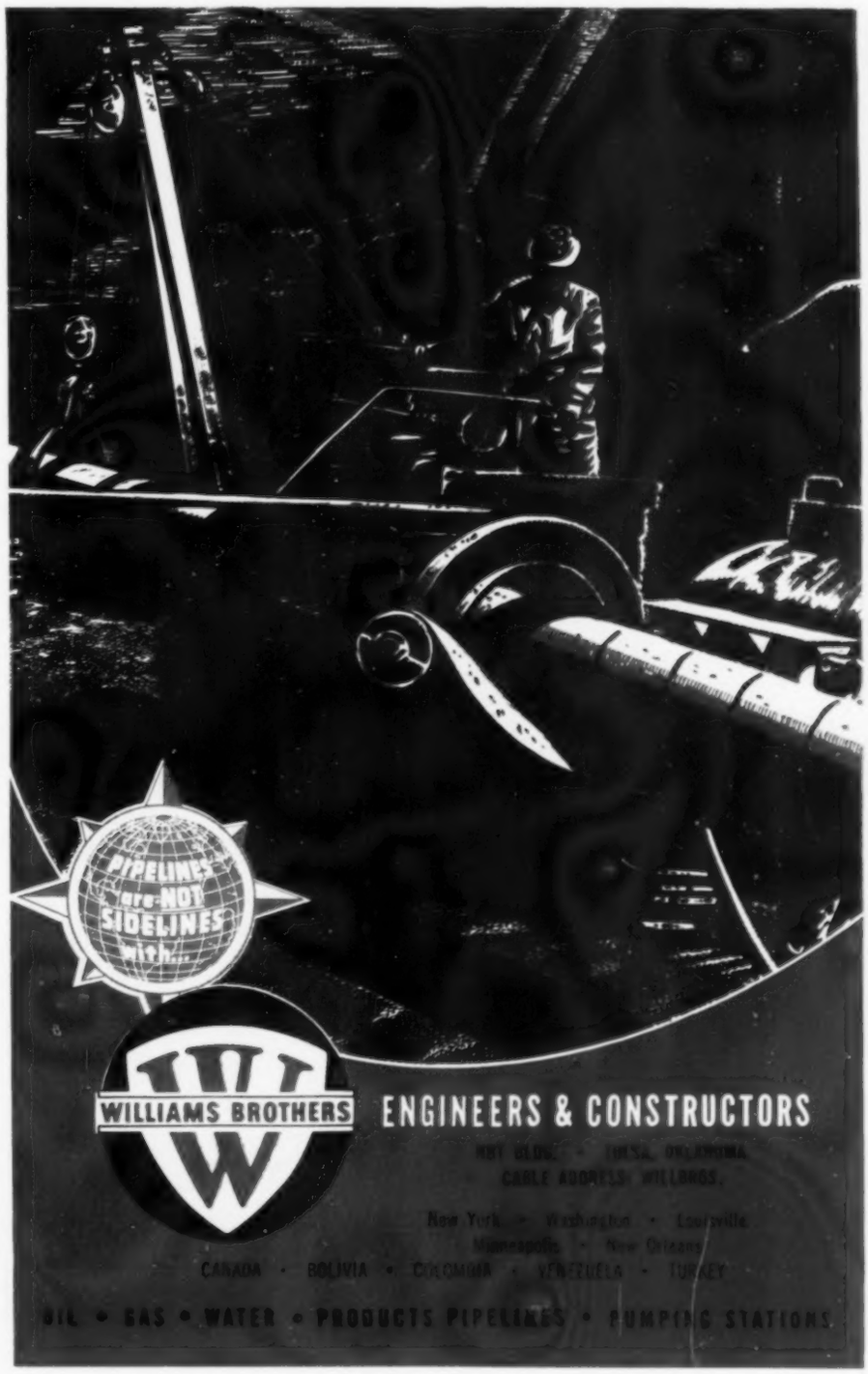


Middle East Pipe Line Proposed to Bypass Suez

Plans for a crude oil pipe line in Israel from Eilat on the Gulf of Aqaba to the Mediterranean, bypassing the Suez Canal, is being considered by both Israel and France. The French have indicated they will put up a large amount of the $60 million cost.

Political agreement over navigation through the Straits of Tiran at the Red Sea entrance to the Gulf of Aqaba is delaying final decision on construction of the line. If assured of free navigation through the Gulf, Israel has indicated it would proceed with plans for a 30-inch pipe line from Eilat to the Mediterranean to carry Middle East oil to Western Europe.

Israel is now building an 8-inch line from Eilat to Beersheba, approximately 150, miles with a capacity of 50,000 barrels a day to handle Israel's own oil imports. From Beersheba, crude can be moved by rail to the refinery at Haifa. An extension of the pipe line from Beersheba to Haifa is also being considered.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For more data on advertised products, use Readers' Service Cards, last page.

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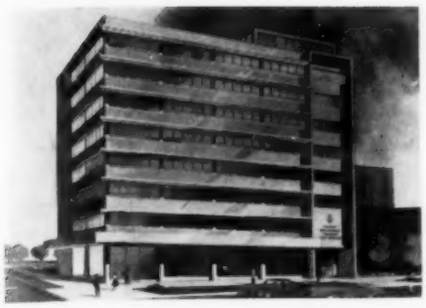


New Building

Pacific Northwest Pipeline Corporation has announced plans for a new $2½ million, eight-story headquarters building in Salt Lake City. Construction is to begin immediately. The new headquarters will display almost 50 percent heat resistant glass area in aluminum-framed windows. The remainder of the outside structure will be porcelanized steel. In addition to the eight floors, the building will contain conference rooms and offices on a portion of the roof. The acquisition of Pacific Northwest Pipeline by El Paso Natural Gas Company has recently been completed.

Pacific Northwest To Spend $30 Million on Construction

Pacific Northwest Pipeline Corporation will spend $30 million this year for expansion of the company's western regional transmission line from the San Juan Basin to the Pacific Northwest.

The construction program includes 1000 miles of gas field gathering system in the San Juan Basin, an 8000 horsepower compressor station at Sumas, Wash., and a 2000 horsepower compressor in the Big Piney field in Wyoming.

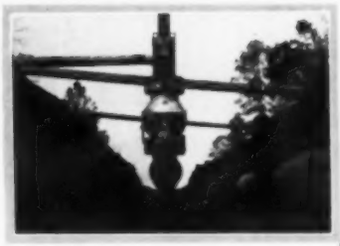
Alberta Gas Trunk Line To Build Gathering System

Alberta Gas Trunk Line Company, Ltd., has signed a 25-year contract with Trans-Canada Pipe Lines, Ltd., covering transport of the gas which Trans-Canada has purchased for export from Alberta.

Alberta Gas Trunk Line will build its $47 million gathering system in Alberta over a four-year period. When completed, the system will be capable of transporting 620 million cubic feet of gas daily to Trans-Canada's tie-in point on the Saskatchewan boundary.

First stage of the construction program, planned for 1957, includes 100 miles of 18-inch lines and 16 miles of 34-inch lines to connect with the Bindloss and Provost fields.

The second stage of the program will be built in 1958 to take gas from the Sibbald-Oyen, Cessford-



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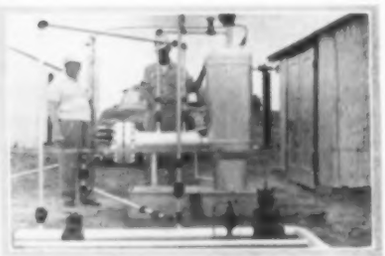

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You can depend on Topaz sales engineers to be on the job--on time--working in cooperation with your engineering department. Topaz service includes furnishing all equipment on a lease, contract or purchase basis. Call Topaz day or night . . . we'll be there!

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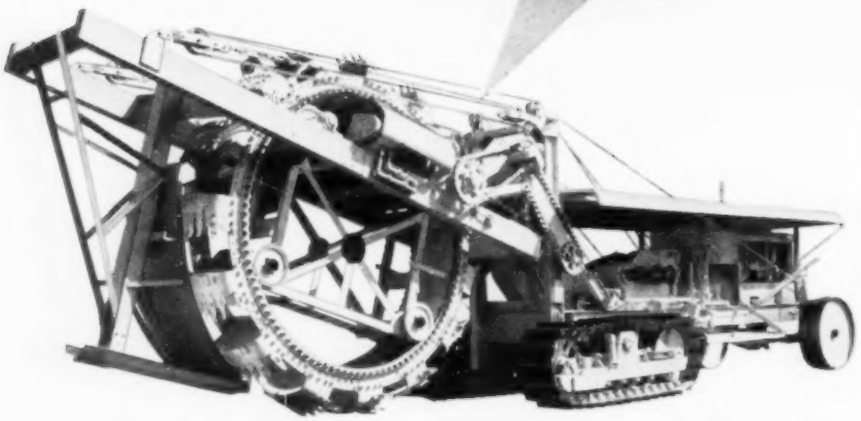
ADDED TO PARSONS LINE



BIG-INCH 520 . . . MIDDLE-INCH 420

Rounding out a complete line of *Trenchliners for pipeliners*, Parsons now brings you 2 big, wheel-type machines — both *job-proved* on cross-country work

Big-Inch model 520 (above) opens up to 28 lineal feet of trench per minute, depending on depths, widths, and job conditions. It digs 40 to 52 inches wide — at depths to 8½ feet. With Parsons Middle-Inch model 420, you get digging speeds up to 44 feet per minute — trench widths from 31 to 46 inches, and depths to 7½ feet.

Originally developed by C-R-C, and now built by Parsons, these two big-wheel ditchers bring you the combined engineering know-how and services of both firms. It will pay you to get more complete information on what one of these heavy-duty Inchers can do for you.

Other Parsons Trenchliners include a smaller, wheel-type 150 (below) — and ladder-types on rubber or crawlers, in a complete selection of sizes to serve all your needs.

PARSONS COMPANY, Division of Koehring

As an auxiliary production unit to the Big and Middle-Inchers, this smaller wheel-type 150 digs laterals, gathering-lines, etc., at speeds up to 25 feet per minute. It opens trench 16 to 30 inches wide, 5¾ feet deep. Hydraulic wheel-hoist gives infinite depth adjustments, maintains close grade tolerance.

Want more facts?

PARSONS COMPANY, Newton, Iowa

Send us literature on: ☐ 520 Big-Inch ☐ 420 Middle-Inch ☐ 150 Trenchliner

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PARSONS TRENCHLINERS® for PIPELINERS

Sunnybrook, Princess-Patricia, Atlee-Buffalo and Pincher Creek fields.

Stage 3 will be built in 1959 to take delivery from the Nevis field and in 1960 the fourth stage of construction will be to tap the Homeglen-Rimbey, Gilbey and Countess-Duchess fields.

Manufacturers Light & Heat To Build $3.6 Million Facilities

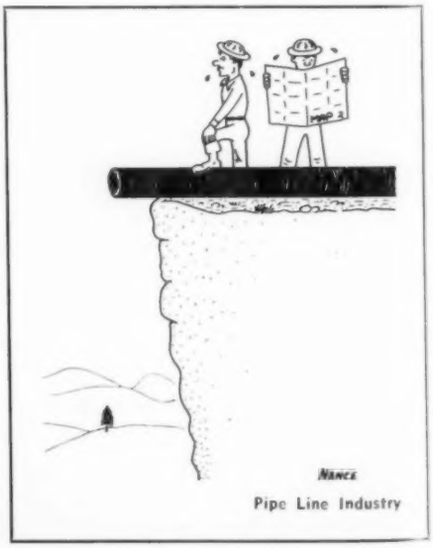
The Manufacturers Light and Heat Company has received temporary authorization from the Federal Power Commission to construct and operate a 5280 horsepower compressor station and other facilities estimated to cost $3.6 million in Marshall County, W. Va.

The new compressor station will replace an existing 2500 horsepower Majorsville compressor station in Washington County, Penn. The company proposes to abandon the existing station at the end of the 1957 storage input season.

Interstate Oil Pipe Line's 39-Mile LPG Lines Underway

Construction is underway by Fowler Tatom Pipeline Contractor on four 39-mile LPG pipe lines from Baton Rouge to Sorrento, La., for Interstate Oil Pipe Line Company.

The project, which includes four 39-mile lines laid in a common ditch, includes two 4-inch, one 6-inch and one 8-inch line from the Baton Rouge refinery of Esso Standard Oil Company to Sorrento. Completion is expected in April.



NOW you can enter against pressure for Corrosion Control

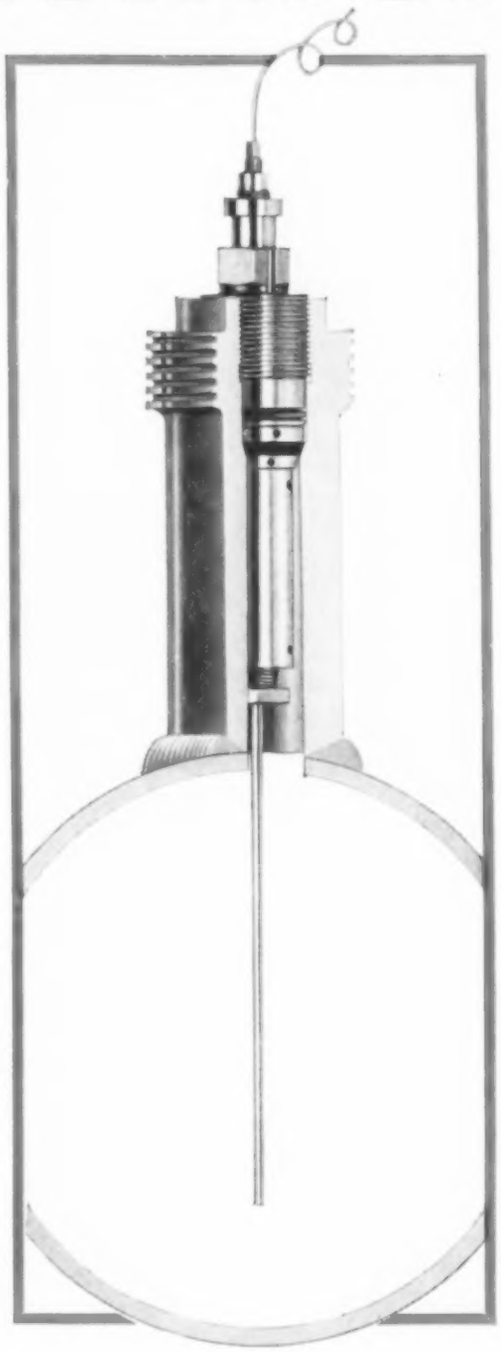
Safely...Economically!

Without interfering with operations, you can now go into vessels and pipe lines on stream to investigate corrosion, its rate, cause and effects. This is possible when COSASCO *Access* Nipples are installed at strategic locations as pressure-proof ports for the insertion of coupons and to secure data with water samplers, thermocouples and hydrogen probes.

While coupons continuously provide means of recording rate of corrosion, samplers permit periodic analysis of possible causes, thermocouples contribute desired temperature readings and the hydrogen probe helps to determine the concentration of free hydrogen present. With such information at hand, intelligent application of measures for control can be made to prolong equipment service life, reduce or eliminate product pollution and, consequently, protect important capital investment. In many cases, product quality can be more easily maintained.

COSASCO *Access* Nipples may be installed at any time: either during shutdown or, with a COSASCO Hot Tapping Assembly, while vessel or line is under full operating pressure.

The *Access* Nipples have removable low-carbon type 303-304 stainless steel plugs. Special plugs for the samplers, thermocouples, and hydrogen probes are also of this highly corrosion-resistant material. COSASCO *Access* Nipples are applicable to any pressure or storage system, hydraulic or gaseous.



COSASCO

THERMOCOUPLE *ACCESS* PLUG

Here a Thermocouple Plug is shown in place in an *Access* Nipple welded to a tapped pipe line. The closed-end tube extending into the line contains the iron-constantine wire inserted through the plug. The entire assembly is completely pressure-proof. Plugs fitted for water sampling and probing for hydrogen are basically similar. Details will be supplied on request.

What's your problem?

If it's an entry-against-pressure problem, COSASCO engineers invite you to submit details. Send blueprints or drawings to depict the problem, and the COSASCO solution will be supplied *without* charge. You will be under no obligation whatever for this service.

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Pacific Gas and Electric To Complete Looping of Line

Plans have been announced by Pacific Gas and Electric Company to complete the looping of the "Super Inch" natural gas transmission line by the end of this year.

Since the original 502-mile 34-inch line was placed in operation in 1950, Pacific Gas and Electric has been adding paralleling sections between the line's southern end on the Colorado River side of San Bernadino County, and its northern terminus near Milpitas. (See PIPE LINE INDUSTRY, July, 1956, page 68.)

Of the 138 miles of single section remaining, parallel pipe lines for 65 miles of this length already are authorized. Recently the company has requested authorization for the remaining 73.5 miles. With compressor installations, this addition is estimated to cost $9.3 million.

The project will raise capacity to 950 million cubic feet and the installation of more compressor capacity in 1958 will increase deliveries to one billion, 25 million cubic feet daily.

Transco Receives Approval For $5 Million Facilities

Transcontinental Gas Pipe Line Corporation has received temporary authorization to construct and operate natural gas facilities in Texas and Louisiana estimated to cost $3.7 million.

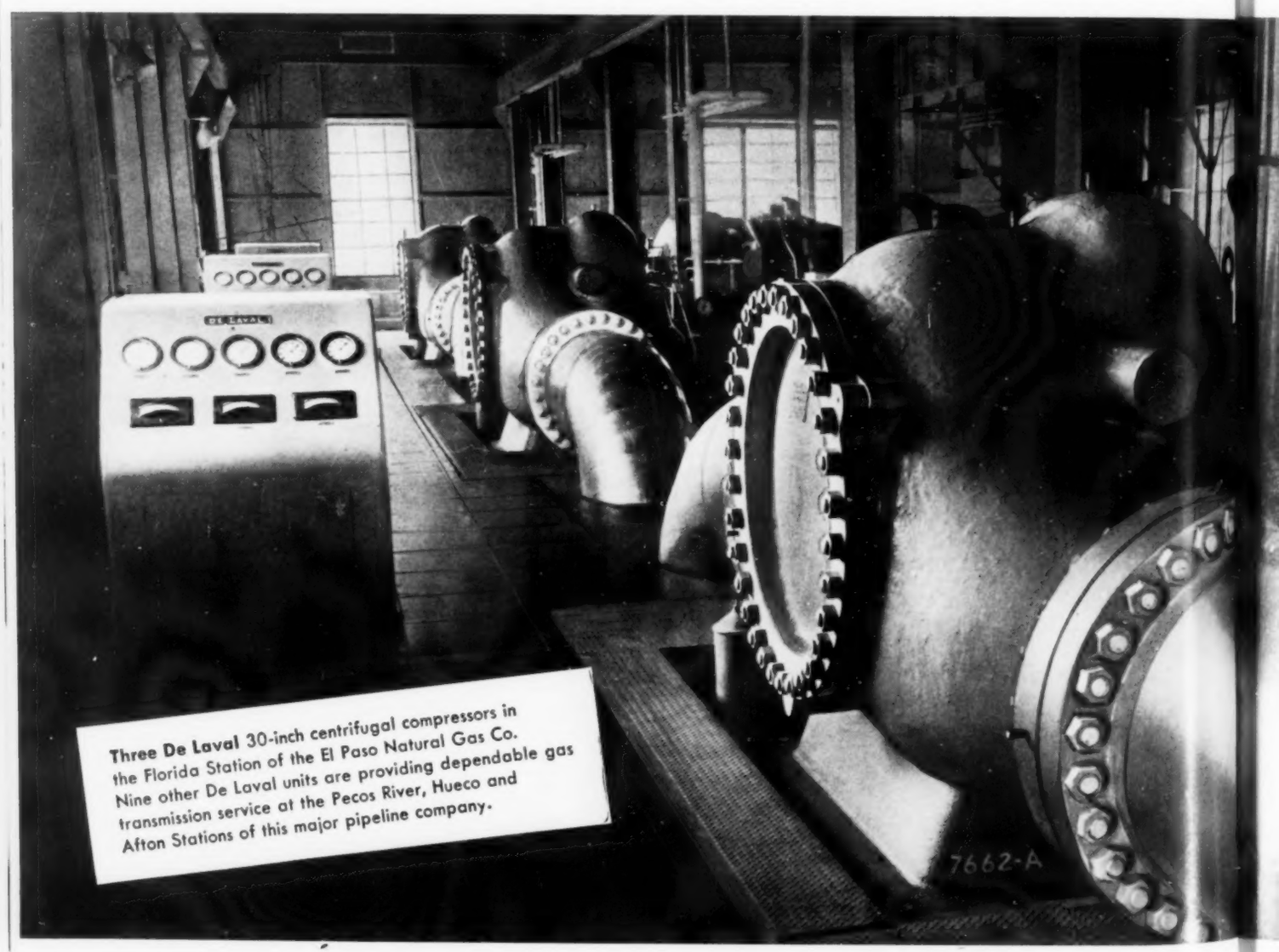
The Federal Power Commission also has authorized Transco to install proposed facilities estimated at $1.4 million to increase deliveries to Shelby, N. C. This includes construction of an additional 2500 horsepower at Station 6 in Louisiana and 2500 additional horsepower at Station 8 in Mississippi.

The temporary approval is for construction of the 880 horsepower Mission Valley booster station in Victoria County, Texas; and 880 hp booster station and dehydration station in Luby field, Nueces County; and an 880 hp booster station, a dehydration station and purchase meter in Gretta field, Refugio County. Installation of an additional 3550 hp at Station 23 in Harris County, Texas, and 5000 additional hp at Station 24 in Beauregard Parish, La., was included in the temporary authorization.

Longest Aluminum Pipe Line Laid in South American Jungle

A 42-mile 6-inch aluminum pipe line, reported to be the longest aluminum pipe line ever assembled, will be used in South American jungle country to transport crude oil from an outlying producing field to a tank farm.

The line will link Colombian Petroleum Company's Tibu field to the firm's producing installation at Rio de Oro.



Three De Laval 30-inch centrifugal compressors in the Florida Station of the El Paso Natural Gas Co. Nine other De Laval units are providing dependable gas transmission service at the Pecos River, Hueco and Afton Stations of this major pipeline company.

Construction Underway on Crude Line For Union Oil Company of California

Construction is underway on Union Oil Company of California's 225-mile crude pipe line, the longest line ever laid in California, to carry crude oil and unfinished petroleum products from the San Joaquin Valley to the company's Oleum refinery on San Francisco Bay.

The line will be of 12-inch pipe from Union's present Junction pump station to a new station being constructed near Coalinga. From there, aided by a booster station near Patterson, the oil will move through a 16-inch line to the refinery. Designed for a throughput capacity of 75,000 barrels daily, the line can be increased to 100,000 barrels a day with additional booster stations.

The project will tie in with two existing 8-inch lines between Junction and Avila on the coast. One line carries crude from the San Joaquin Valley to Union's Santa Maria refinery. Flow will be reversed through the second line to carry Santa Maria's production of cracking stock and pressure distillates to Junction, with the new system taking it on to Oleum.

Roy Price, Inc., is contractor on the job with four spreads at work. The line is expected to be in operation by May 1. Completion of pump stations and storage tanks required for full design operation is scheduled for August.

Southern Natural Proposes $1.5 Million Facilities

Southern Natural Gas Company has applied for authorization to construct and operate facilities in Louisiana estimated to cost $1.5 million.

The facilities proposed include 10.5 miles of 8⅝-inch pipe line, including a submarine crossing of the Mississippi River; two measuring stations; and to install two 660-horsepower compressor units at the Toca compressor station, one 550-hp compressor at White Castle compressor station, and one 1350-hp compressor unit at the Gwinville compressor station.

New Inflatable Pipe Reported Tested in USSR

A new type of pipe for carrying oil, gas or water is reportedly being tested in the U.S.R.R. Made in the form of two steel strips electrically welded along the edges, it is laid by unrolling the pipe from a moving lorry.

After the pipe is laid, it is inflated by air to assume the conventional round shape. The tubes are made in sections one kilometer long and are capable of withstanding a pressure of 220 pounds per square inch.

DE LAVAL

CENTRIFUGAL COMPRESSORS

on the job at El Paso Natural Gas

De Laval centrifugal compressors offer many important engineering features. (1) They are designed to handle an increased ultimate flow, can be quickly converted to larger capacities by replacing the impeller, diaphragm and a few minor parts. (2) The high pressure shaft seal eliminates leakage, consumption of sealing oil is negligible. (3) There is only one moving part—the rotor—which has ample clearance. (4) Units are compact, require smaller foundations and smaller stations. (5) First costs and installation costs are low.

Bulletin 503 gives data on De Laval Centrifugal Compressors. Write for your copy.

DE LAVAL *Centrifugal Compressors*

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Colorado Interstate Plans New Station Facilities

Colorado Interstate Gas Company has received authorization from the Federal Power Commission to construct natural gas facilities costing $1.6 million, including three new meter stations and 35 miles of pipe line.

The project includes meter stations at South Denver, North Pueblo and South Pueblo, Colo., and 26-inch and 8-inch loop lines from the East Denver control station to the Hampden Avenue station and from the Portland, Colo., lateral serving the Portland-Florence-Canon City area.

Colorado Interstate will transfer other facilities including about 20 miles of pipe line and six metering and regulating stations to four distribution companies.

Gathering System Purchased By Ben Franklin Refining

Ben Franklin Refining Company, subsidiary of Bell Oil and Gas Company, has acquired the Cotton County Gathering system of the Service Pipe Line Company and the 8-inch line connecting the principal gathering system running from Cache Creek, Okla., to Healdton, Okla. There it joins the Ben Franklin main gathering system serving the Ardmore refinery in Cotton County.

Ben Franklin also acquired from the Cherokee Pipe Line Company 10 miles of 8-inch line beginning at Cherokee's Hewitt station.

Scurry-Rainbow Oil Merges With Canadian Pipelines

Merger of Scurry-Rainbow Oil Limited and Canadian Pipelines & Petroleums Ltd. has been approved by the boards of directors of the companies. The combined company will retain the corporate name of Scurry-Rainbow Oil Limited.

Continental Buys Crude Line In Texas from Gulf Oil

Continental Pipe Line Company has purchased a 99-mile 6-inch crude oil pipe line from the Wichita Falls area in Texas to Saginaw near Fort Worth and plans to extend the line to the Grapevine area. Formerly owned by Gulf Oil Corporation, the line is being converted to refined product service. Continental recently began moving gasoline from its Wichita Falls refinery through the line to temporary terminal facilities at Saginaw.

Conoco also announced plans to construct a petroleum products terminal, costing approximately $320,000 which will be at the eastern terminus of the line after completion of the extension from Saginaw.

NATO Plans 124-Mile Pipe Line in Italy

Bids have been opened to U. S. bidders under the international competitive bidding procedure of the North Atlantic Treaty Organization (NATO), the Bureau of Foreign Commerce, U. S. Department of Commerce, for construction of a 124-mile pipe line and three pumping stations at Parma-Bologna, Italy.

Bids are received by the Ministero Difesa-Aeronautica, Direzione Generale Demanio, Ufficio Studi, la Sezione, Viale Castro Pretorio, Rome.

Proposed Pipe Line Construction

COMPANY	Length in Miles	Diameter	Type	Origin and Terminus	Estimated Cost	Status
Alberta Gas Trunk Line, Ltd.	116	18, 34	Gas	To connect with Bindloss and Provost fields	.....	Planned
American-Louisiana Pipe Line Co., Detroit	....	12-16	Gas	From No. Holly Beach field and Second Bayou field, Cameron Parish, La.	.....	Before FPC
Andes Pipeline Corp.	500	12	Gas	From Villamontes, Bolivia to Antofagasta, Chile.	$30 million	Planned
Bolivian Gulf Oil Co.	201	8-10	Crude	Sicasica, Bolivia to Arica, Chile	$10.5 million	Planned
	....	14	Crude	Camiri field to Santa Cruz	.....	Considered
British Petroleum Company	....	16	Crude	Popton Point, South Wales, to Llandarcy refinery	$14 million	Considered
Cities Service Gas Co.	60	4-12	Gas	In Grant and Alfalfa Counties, Okla.	$1.3 million	Contract let
Coastal Transmission Corp.—Houston, Texas	565	20-26	Gas	McAllen, Texas—Louisiana connection, Houston, Texas Gas, plus 272 miles of laterals	$68 million	Authorized
Colorado Interstate Gas Co., Colorado Springs, Colo.	734	22-34	Gas	Texas & Oklahoma Panhandle to Kit Carson, Colo., to Beatrice, Neb.	$87 million	Before FPC
	36	26	Gas	East Denver to South Denver station and loop of Portland lateral	$1.3 million	Authorized
Compania Shell de Venezuela	177	20	Gas	La Paz field to Cardon refinery on Paraguana peninsula	$20 million	Planned
Consolidated Gathering Systems, Ltd.	198	....	Crude	Sturgeon Field—Edmonton	.....	Planned
Creole Petroleum Corp.	94	28	Crude	Temblador to Caripito, Venezuela	$5.6 million	Planned
Deep Rock Gas Co.	120	6	LPG	Tioga, N.D.—Canadian border	.....	Planned
El Paso Natural Gas Co.	290	....	Gas	Facilities in Texas, New Mexico, and Arizona to deliver gas near Blythe, Calif. and Topock, Ariz. to So. Counties Gas Co., So. Calif. Gas Co. and Pacific Gas & Electric Co.	$84.5 million	Authorized
	108	....	Gas & Products	Facilities in Andrews and Ector Counties, Texas	$5 million	Authorized
	28	10	Gas	Nolan and Coke Counties, Texas, plus compressor station facilities	$1 million	Authorized
El Paso Natural Gas Products Co.	240	8	Products	Midkiff natural gasoline plant in Permian Basin to El Paso	.....	Planned
Four Corners Pipe Line Co.—Houston	600	16	Crude	From Four Corners Area to Los Angeles plus 150 miles of feeder lines	$50 million	Planned
Great Lakes Pipe Line Co., Kansas City, Mo.	84	8	Products	Extension of system to Eau Claire, Wisc.	.....	Planned
	68	12	Products	From intersection of system with Badger Pipe Line, into Chicago.	.....	Planned
Houston Texas Gas & Oil Co.—4604 Main St., Houston	961	12-30	Gas	Baton Rouge, La. to Miami, Fla. plus 496 miles of laterals and compressor facilities	$105 million	Authorized
International Petroleum Co.	180	...	Crude	Pasto, Colombia, to Pacific port of Tumaco	.....	Considered
Interprovincial Pipe Line Co.	150	20	Crude	Sarnia, Ont. to Toronto, Ont.	$26 million	Planned
Iraq Government	150	....	Gas	Kirkuk field to Baghdad	.....	Considered
Iraq Petroleum Co.	1,200	38-40	Crude	Kuwait to Iskenderun, Turkey	.....	Considered
Iron Ranges Natural Gas Co.	115	....	Gas	From Itasca and St. Louis Counties along route of Mesabi range from Grand Rapids to Aurora, Minn.	$5 million	Before FPC
Iroquois Gas Corp.—Buffalo, N.Y.	36	....	Gas	Facilities in Chautauqua, Cattaraugus and Erie counties, N.Y. to develop new underground storage area.	$2.8 million	Authorized
Israel Government	70	6	Products	Haifa to Tel Aviv	$1 million	Contract let
Kansas-Nebraska Natural Gas Co.	11.5	12	Gas	Near Oakley, Kansas	.....	Contract let
	10	10	Gas	North of Grand Island, Neb.	.....	Contract let
Lone Star Gas Co. Dallas	230	22-26	Gas	Cotton County, Okla. to Fritch, Texas	$18.7 million	Before FPC
Magna Pipeline Company	40	....	Gas	Underwater line from Anacortes, Wash. to Victoria, B.C.	$6 million	Planned
Mene Grande Oil Co.	62	30	Crude	Anaco to Puerto La Cruz, Venezuela	$5.8 million	Considered

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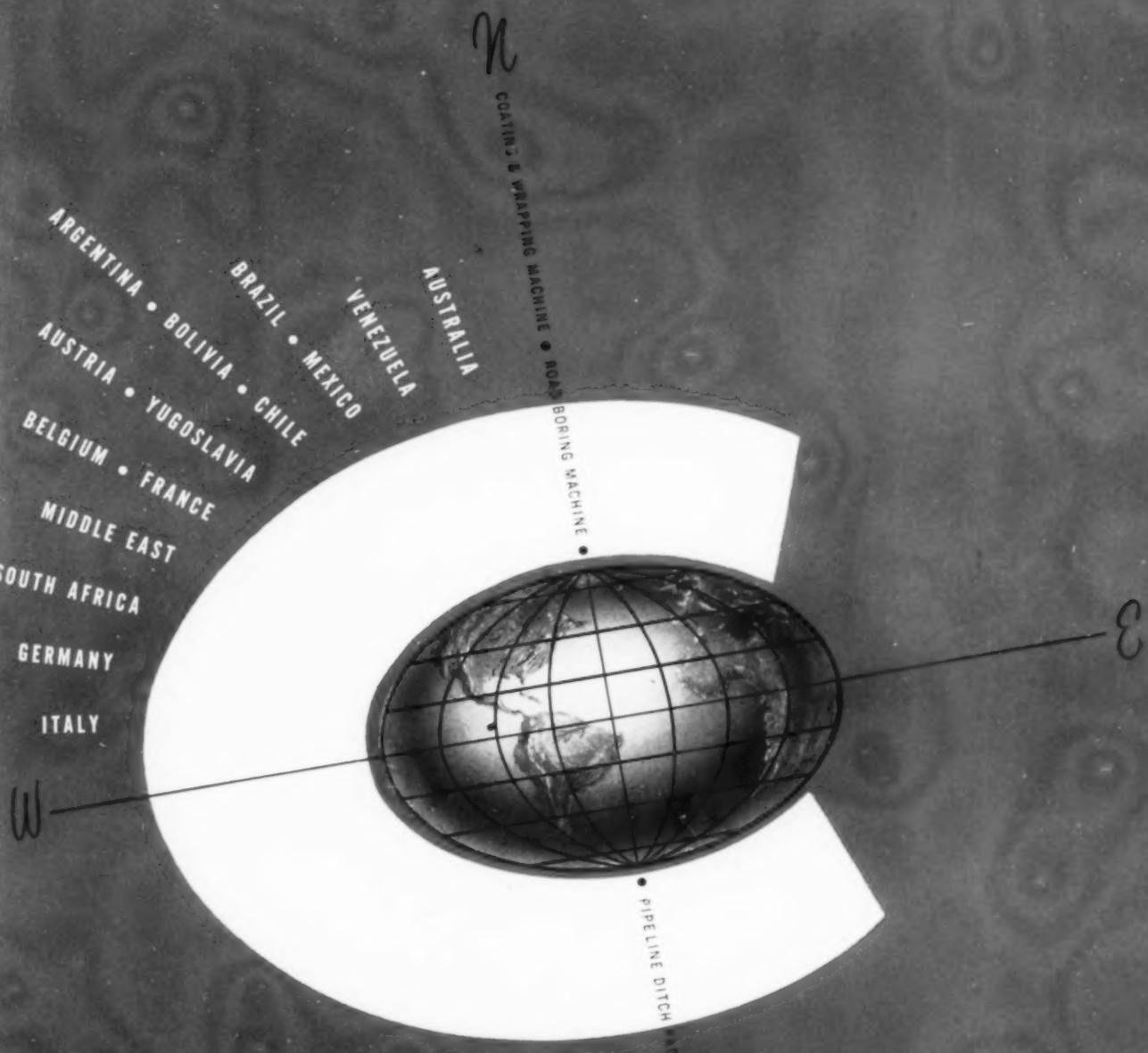

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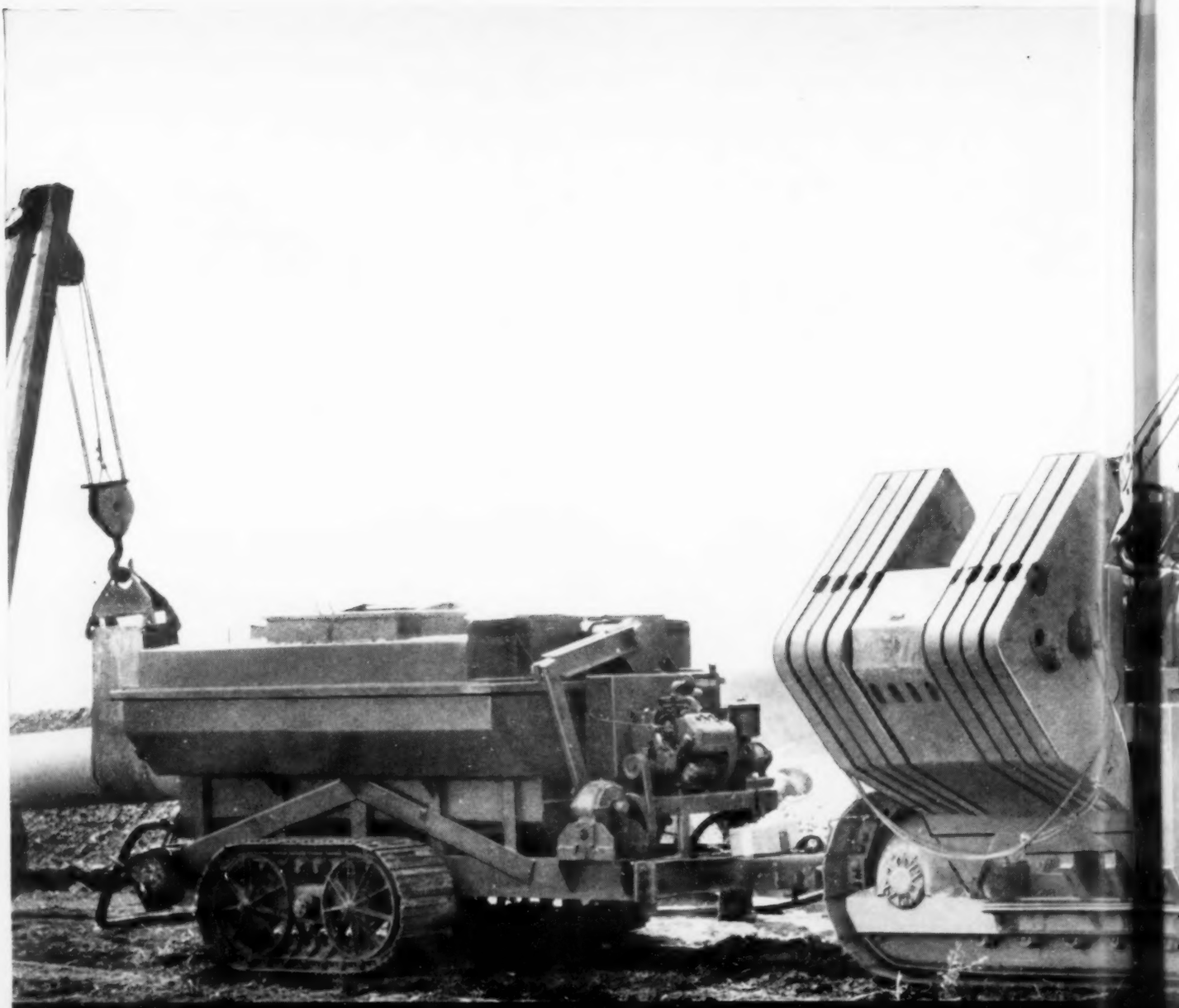


KEEP PIPE HANDLING COSTS DOWN . . .

Torque converter drive . . . matches power and speed to job requirements automatically . . . cushions entire power train and mounted equipment.

Double-reduction final drive and smooth underside . . . give extra clearance for working on irregular terrain.

1,000-hour lubrication intervals for truck wheels . . . eliminate daily greasing . . . convert maintenance time to working time.

One-piece steering clutch and final drive housing . . . insure perfect gear alignment, long life.

Unit construction . . . major assemblies can be removed without disturbing adjacent parts . . . makes service simple, fast.

Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

Just a few of the basic advantages that help this Allis-Chalmers Tractor-Tractomotive side boom

ALLIS-CHALMERS ***. . . crawler tractors***

. . . with help like this!

Internal expanding brakes . . . protected from dirt and water . . . provide positive control of load and boom line drives.

Safety link extendable counterweights . . . controlled hydraulically and mounted high for maximum clearance.

Convenient controls . . . easy operating, positive, conveniently located.

Quick-on, quick-off sectional boom frames . . . pin-connected for fast attachment or removal for transport.

Simplified transmission . . . one lever switches boom or load line from raise through neutral to power down—no gear shifting necessary.

Tractomotive Corporation, Deerfield, Illinois.

combination speed output . . . give you bigger profits. Now is the time to have them working for you.

TRACTOMOTIVE ***. . . side booms***

For more data on advertised products, use Readers' Service Cards, last page.

Proposed Pipe Line Construction—(Continued)

COMPANY	Length in Miles	Diameter	Type	Origin and Terminus	Estimated Cost	Status
Michigan-Wisconsin Pipe Line Co.—500 Griswold, Detroit	472	4-24	Gas	Main line loops and extensions in Wisconsin, Illinois	$17.6 million	Before FPC
Midwestern Gas Transmission Co., Houston, Texas	1112	....	Gas	Emerson, Manitoba—Nashville, Tenn.	$98 million	Before FPC
Mountain Fuel Supply Company	38	20	Gas	Parallel line and facilities to transport gas from Pacific Northwest line in Sweetwater County, Wyo.	$3 million	Authorized
NATO	1920	4-10	Products	To serve military bases in Western Europe	.....	Some contracts let
Natural Gas Pipe Line Co. of America—20 N. Wacker Dr., Chicago	350	20, 26	Gas	Wise County, Texas—Fritch, Texas	$28.5 million	Authorized
	25	....	Gas	Quinduno field in Roberts County, Texas	$3.2 million	Authorized
	416	36	Gas	Loops at various points along existing line	$76.2 million	Before FPC
New York State Natural Gas Corp	27	....	Gas	Elk County, Penn. to Luthersburg gas field in Clearfield, Jefferson and Indiana Counties, Penn.	$1.5 million	Authorized
North Carolina Natural Gas Corp.	575	3-16	Gas	Mooresville eastwardly across North Carolina	$13 million	Authorized
Northern Natural Gas Co.—2223 Dodge St., Omaha	167	24	Gas	Farmington, Minn. to Duluth, Minn. and Superior, Wis.	$12 million	Before FPC
	42	10	Gas	Rochester, Minn. to Winona and Goodview, Minn.	$963,000	Before FPC
North-West Pipelines Co.	200	....	Crude	Wilhelmshaven on North Sea to Ruhr area of Germany	$46 million	Approved
Northwest Pipeline Corp.	350	6-10	Crude & Products	Four Corners area to Salt Lake City, Utah	$15 million	Planned
Offshore Gathering Corp., Houston	364	24, 26, 30	Gas, Crude	Texas side of Sabine River 25 miles offshore La. to Mississippi side of Pearl River	$150 million	Planned
Ohio Fuel Gas Co., Columbus	19	6-16	Gas	Loops on existing line to serve Dayton and Toledo areas and extension to McCutchenville, Ohio	$772,360	Authorized
	31	....	Gas	Plus storage facilities in Vinton, Holmes, Medina, Wayne, and Ashland Counties, Ohio	$2.5 million	Authorized
Ohio Oil Company, Findlay, O.	....	....	Products	Wood River, Ill. to Chicago	.....	Planned
Oklahoma Natural Gas Co., Tulsa	16	8	Gas	Connect gas supplies in Gotebo field, Okla., to Clinton System in Western Okla.	$350,000	Planned
Pacific Gas & Electric Co.	223	34	Gas	Various loops, between Topock, Ariz.—Milpitas, Calif.	$20 million	85 miles let
	200	12	Gas	Northern California gas fields to Humboldt County, California	$9.5 million	Planned
Pacific Northwest Pipe Line Corp.—Salt Lake City, Utah	50	4-6	Gas	To serve industrial customers at Uravan and Nucla, Colo.	$1 million	Authorized
Pembina Pipe Line, Ltd.	100	....	Crude	Gathering line and new pumping unit in West-Central Alberta	$4.5 million	Planned
Pennsylvania Gas Co.	38	8, 10	Gas	In Erie and Warren Counties, Penn., and Chautauqua County, N.Y.	$930,000	Before FPC
Permian Basin Pipeline Co., Omaha, Neb.	83	16	Gas	Facilities near Spraberry compressor station, Midland County, Texas, to tie in with Pioneer Gathering System, Schleicher County, Texas.	$5 million	Before FPC
Petroargentina	370	16	Crude	Newguen—Bahia Blanca, Argentina	$40 million	Planned
Petroleos Mexicanos—Ave. Juarez, 94, Mexico City	440	20	Gas	Brazil—Tampico—Poza Rica, Mexico	.....	Planned
	145	12	Crude	18 de Marzo Field—Monterrey, Mexico	.....	Considered
	80	8	Products	Guaymas—Los Mochis	$1 million	Planned
Piedmont Gas Co.—Hickory, N.C.	78	2-8	Gas	From connection with Transcontinental Gas Pipe Line to serve customers in North Carolina	$2.6 million	Before FPC
Royalite Oil Co.—Calgary	350	....	Crude	Athabasca tar sand plant in Northeastern Alberta to Edmonton	.....	Planned
Saskatchewan Power Corp.	80	....	Gas	Hatton gas field to Success, Sask.	.....	Planned
	40	....	Gas	Moose Jaw, Sask. to Regina, Sask.	.....	Planned
Scranton-Spring Brook Water Service Co.	27	12	Gas	Hebron-Greenwich facilities of TGT to Scranton and Wilkes-Barre, Pa.	$1.6 million	Authorized
Service Pipe Line Corp., Continental Pipe Line Co., Sinclair Pipe Line Co. and Phillips Petroleum Co.	....	....	Products	Salt Lake City to Spokane, Wash.	.....	Considered
Shell Oil Company and Standard Oil Co. of California	600	14	Crude	Four Corners area to Los Angeles area	.....	Considered
Southern Natural Gas Company	52	....	Gas	Various locations in Ga. and La.	$2.2 million	Authorized
Stanmount Pipe Line Co.	140	10	Crude	Cayuga and Beaver Lake Fields, N.D. to connect with Interprovincial Pipe Line	.....	Planned
Sturgeon Pipe Line Ltd.	100	12	.....	Sturgeon Lake Field—Trans-Mountain system	$6.5 million	Planned
Tecumseh Pipeline Co.	190	20	Crude	To connect to principal crude line carriers in Chicago area for movement to east	.....	Planned
Tennessee Gas Transmission Co.—Box 2511, Houston (See also Midwestern Gas Transmission Co.)	100	....	Gas	Gathering lines in Texas and Louisiana plus station additions	$18.6 million	Before FPC
	1085	12-30	Gas	Southeast La. to Portland, Tenn.; from Kinder, La., to offshore wells in Gulf of Mexico; from Coudersport, Penn., to Hamburg, N.Y., and loop lines in Ky., W. Va., Penn.; compressor stations in Miss., Tenn., N.Y., Penn.; and additions in Tenn., Ky., Ohio, and Penn.	$166 million	Before FPC
Texas Eastern Transmission Corp., Shreveport, La.	77	30	Gas	Loops at various points between Kosciusko, Miss. and Uniontown, Penn.	.....	Authorized
Texas Gas Transmission Corp.	40	6-30	Gas	Parallel lines and compressor additions on existing lines in Louisiana, Missouri, Mississippi, Illinois, Kentucky	$6 million	Authorized
	....	....	Gas	To deliver gas from four Louisiana gas fields to American Louisiana system.	$783,100	Authorized
	13	20	Gas	East Lake Palcurde line, Assumption Parish, to Thibodaux area, Lafourche Parish, plus metering facilities	$1.5 million	Authorized
Texas Illinois Natural Gas Pipeline Co., Chicago	38	36	Gas	Loops facilities in Illinois	$6.4 million	Authorized
Texas-New Mexico Pipe Line Company, Houston	515	16	Crude	Extension from Jal, N. Mex., pump station to Four Corners.	.....	Planned
Trans-Canada Pipe Line, Ltd.—Calgary, Alberta	2250	30, 36	Gas	Alberta—Eastern Canada	$378 million	Contracts let for 6 spreads
Transcontinental Gas Pipeline Corp.—Houston	287	....	Gas	Loop lines and gathering laterals in Texas and compressor facilities in La., Miss., Ala., Ga., N.C. and Va.	$61.5 million	Before FPC
	28	16	Gas	Lateral in Cameron Parish, La., to take Transco's first offshore gas purchase	.....	Before FPC
Trans-Europe Pipe Line	500	30	Crude	Mediterranean to northern Europe	.....	Considered
Underground Storage & Exploration—Upper Darby, Penn.	394	....	LPG	Moundsville, W. Va. to Marcus Hook, Penn.	.....	Considered
United Fuel Gas Co., Charleston, W.Va.	18	12	Gas	Coco compressor station in Kanawha County, W. Va., to Belle, W. Va.	$845,853	Authorized
United Gas Pipe Line Co.—Shreveport	40	8	Gas	From Baldwin County, Ala. to Container Corp. of America plant, Brewton, Ala.	$1.2 million	Before FPC
United Natural Gas Co.	50	12	Gas	Elk County—Jefferson County, Pa.	.....	Planned
U. S. Navy	450	8	Gas	Gubik Field—Fairbanks, Alaska	$20 million	Planned
Washington Gas Light Co.—Washington, D.C.	28	20, 24	Gas	From metering station of Atlantic Seaboard Corp. to Washington to connect with line leading to District of Columbia facilities	$3.4 million	Authorized
Westcoast Transmission Company, Ltd., Calgary	270	8-26	Gas	Various locations in Peace River region	.....	Contracts let for 155 miles
	174	30	Gas	Savanna Creek gas field, Alberta, to British Columbia border	.....	Planned
Westspur Pipe Line Co.	20	12	Crude	Alida to Carnduff-Glen Ewen area of Saskatchewan plus 34 miles of gathering line	.....	Planned
Winnipeg and Central Gas Co.	450	4-8	LPG	Tioga, N.D.—Winnipeg, Canada	$20 million	Planned
Yacimientos Petroliferos Fiscales	808	....	Gas	Campo Duran, to Buenas Aires, Argentina	$76 million	Planned
	621	....	Crude	Mendoza to San Lorenzo, Argentina	$19 million	Planned
Yacimientos Petroliferos Fiscales Bolivia	86	....	Crude	Yacuiba to Bermejo, Bolivia	$3 million	Considered

Kentucky River Crossing of 26" Texas Gas Transmission Co. line. Pipe and weights protected with Pitt Chem Plasticized Enamel.

Pipeline Reconditioning Here Could Cost A Fortune!

But Pitt Chem Enamel Assures Long-Term Protection and Low Maintenance Cost

THE extra cost of protecting your pipelines with coal tar enamels may look like pin money a few years from now. For the expense of excessive cathodic protection and reconditioning—which is often necessary when "economy" coatings are used—can sky-rocket your maintenance costs out of all economic proportion.

Coal tar enamels have *proved* their superior ability to resist soil stress and water absorption, the two principal reasons why other coating materials repeatedly fail. So why gamble? Specify *Pitt Chem* Coal Tar Enamels, just as scores of leading pipeline companies do each year, and be sure of minimum maintenance and long-lasting protection.

When you specify *Pitt Chem*, you enjoy the advantages of guaranteed quality, for *Pitt Chem* Enamels are manufactured under rigid production control—to *published* specifications. • How can we help you? Send us the details of your coating problem.

PITT CHEM® TAR BASE ENAMELS

• Standard Grade • Modified Grade
• Plasticized Grade • Hotline
• Cold Applied Tar Base Coatings

PROTECTIVE COATINGS DIVISION
PITTSBURGH COKE & CHEMICAL CO.
Grant Building • Pittsburgh 19, Pa.

WSW 6460

COAL CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

How to do it

PIPE LINE HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, PIPE LINE INDUSTRY, P. O. Box 2608, Houston 1, Texas

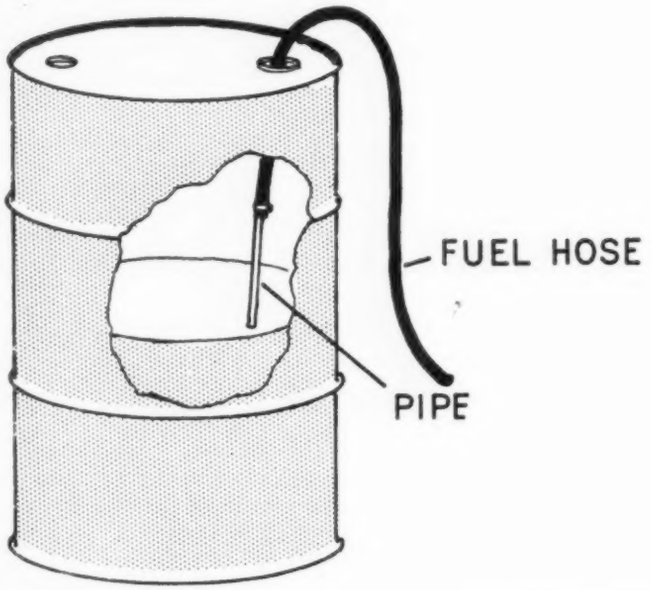
Latch for Station Gate Is Simple to Construct

With a short length of ¾-inch pipe and some scrap rods, this handy latch can be fabricated in a few minutes. The gate shown is made of 1-inch rod with $\frac{5}{16}$-inch rod used for the stationary part of the latch and ½-inch rod used for the movable part.

Cut a piece of ¾-inch pipe about 4 inches long and weld it to the gate post. Slip a 15 to 18-inch piece of ½-inch rod through the pipe and bend as shown, being sure that it will move freely up and down.

The stationary part of the latch is cut from the $\frac{5}{16}$-

inch rod and formed to catch the moving part, holding it snugly in position to avoid a chance of the gate jarring open. The latch can be opened easily from either side.



Use Short Piece of Pipe To Prevent Wicking of Hose

Even the best grade of rubber hose can deteriorate rapidly if hydrocarbons are allowed to wick up the fiber jacket. There are several good ways to prevent this.

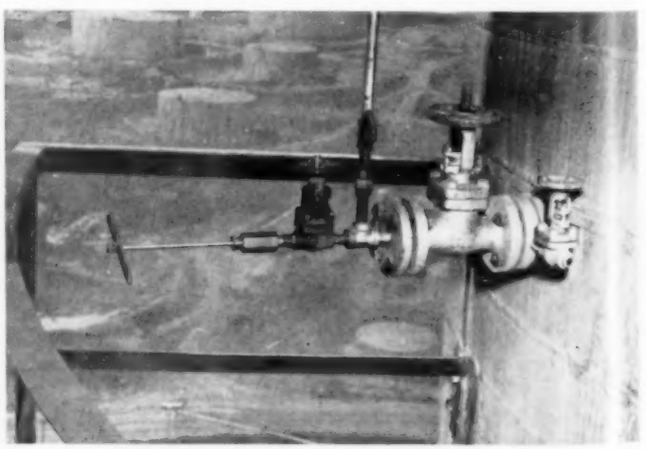
One is to insert a short piece of metal pipe into the rubber hose before placing it in a gasoline drum. The pipe prevents the gasoline from coming into contact with the hose, eliminating the hose failures caused by the fluid attacking the fibers. Capillary action or wicking can result in deterioration for a considerable distance from the exposed end.

In lieu of a short piece of pipe, a film of liquid neoprene rubber compound can be applied to the hose used for filling fuel and lube tanks. The compound will dry into a durable film and prevent the fluids' entrance into the hose fibers. If the hose is to be used in water only, a coating of shellac will serve very well as fiber protection.

Use Easy Way to Clean Pressure Tap Manifold

Pressure taps often become plugged due to the accumulation of fine sand or other foreign material in pressure gage lines. This arrangement allows a complete cleaning without dismantling the entire manifold or trying to use compressed air.

To do this without disturbing the operation, the following procedure may be used. Close the block gate, remove the purge air connection and install a shopmade drill with a packing gland as shown in the photograph. When the block valve is opened, the line can be rodded out with a spade-tipped drill. In this way, the pressure tap manifold can be cleaned and be back in service in a very short time.



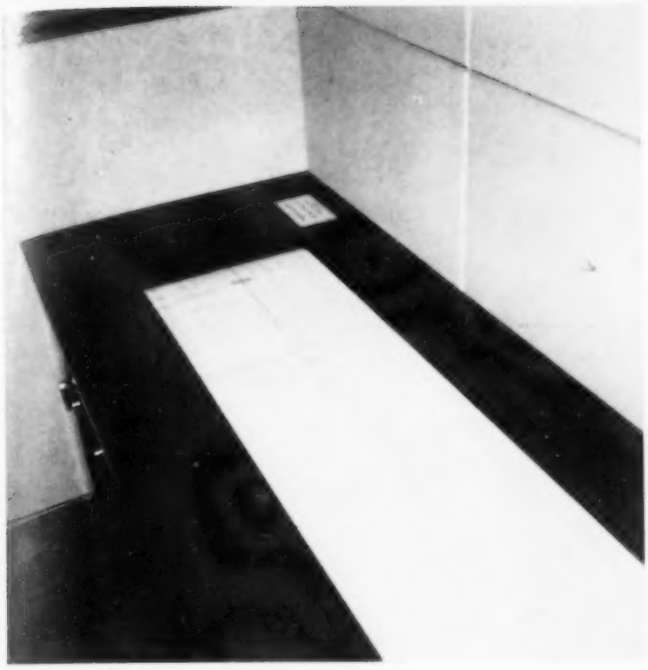


Chart Reels Under Table Keep Corrosion Records Handy

To avoid folding and unfolding bulky strip-maps, one company developed this novel method of recording the pipe-to-soil potentials and soil-resistivity along all of their major lines. Each table holds the records of about 1000 miles of line.

Grids of finished alignment maps afford ideal scales to plot results obtained from test points along the line. A vertical scale is used (volts) that will fit readings to the width of the sheet. "Threshold" readings from 0.5 volts to 0.7 or 0.8 volts may be exaggerated to call attention to corrosion hot-spots. Test readings are plotted above or below the actual test-lead location on the strip-map. Trouble points can be spotted in reference to roads, rivers, rectifiers, or foreign lines as shown on the map.

An entire strip-map is placed on each table, as shown. It is passed through two slots in the table-top, and wound on two crank operated spools at each end of the table. The entire line can be checked, and plotted up to date by merely reeling from one end to the other. This device saves time both in plotting and reading, and does away with the inconvenience of filing numerous maps. Desired records are readily available at all times.

Use Handy Warming System To Help in Starting Engine

Use this handy warming system for easier starting and assurance that an engine will be running during the time specified for the gathering pump to be on the line. This device is being used in Canada and the northern parts of the U. S., where the temperature may remain below freezing for days at a time.

In locations where pumps may remain idle for a week or so at a time, operators use this small gas-fired heater and thermo-siphon heating system to heat the engine coolant before attempting to start up.

To reduce fire hazard, the heater is located some 20 feet from the unit. The two connecting lengths of pipe are run through holes cut in the pump building, and connected to the engine fittings with short pieces of radiator hose.

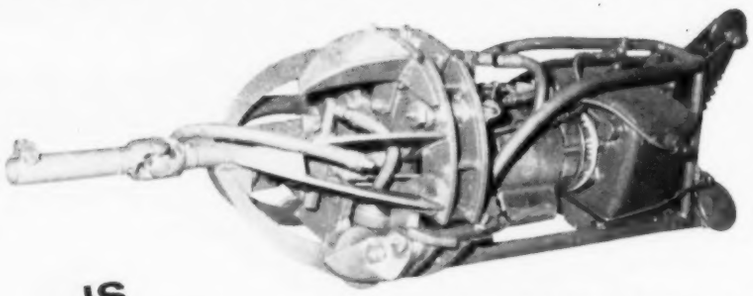
Use Guard for Valves Around Gathering Units

Make this convenient guard for those small diameter lines around gathering units. A short piece of junk 8-inch or 10-inch pipe can be used to protect the valve, as well as adding to the general appearance of the station.

The line, usually a drain or sump line, is laid so the top of the valve wheel is flush with the ground. The pipe, large enough to give sufficient clearance, is placed over the valve and the earth or shell packed back to original level.

the new C-R-C ELECTRO-HYDRAULIC INSIDE

LINE-UP CLAMP



IS POSITIVE POWER EXPANDING

The new C-R-C Electro-Hydraulic Line-up Clamp with tremendous line-up pressure capacity, speeds lining-up operations quickly and safely.

Pressures of 10 to 15 times as much as conventional clamps are brought to bear on large diameter pipe. The clamp is power expanding. No hand-cranking necessary . . . just flip a switch and the clamp does the rest.

Sizes range from 18" to 36" pipe . . . rental basis only.

For complete details on the C-R-C Electro-Hydraulic Line-Up Clamp, send in the form below.

FILL IN BELOW AND MAIL TO

PLEASE SEND INFORMATION ON C-R-C E-H CLAMP

CRUTCHER • ROLFS • CUMMINGS, INC.
P.O. BOX 2073 HOUSTON, TEXAS

NAME _____ TITLE _____

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Use Couplings to Make Table Legs Adjustable

For easily leveled work tables or drawing boards on location in shop or work area, standard couplings on the bottom of pipe legs have proved valuable.

The pipe legs of the table are threaded for the bottom inch or two, and leveling is accomplished by adjusting the separate couplings. A wooden plug may be inserted in the bottom of the coupling to increase the bearing area, and give greater stability.

Air Horn Gives Warning Of Lube System Failure

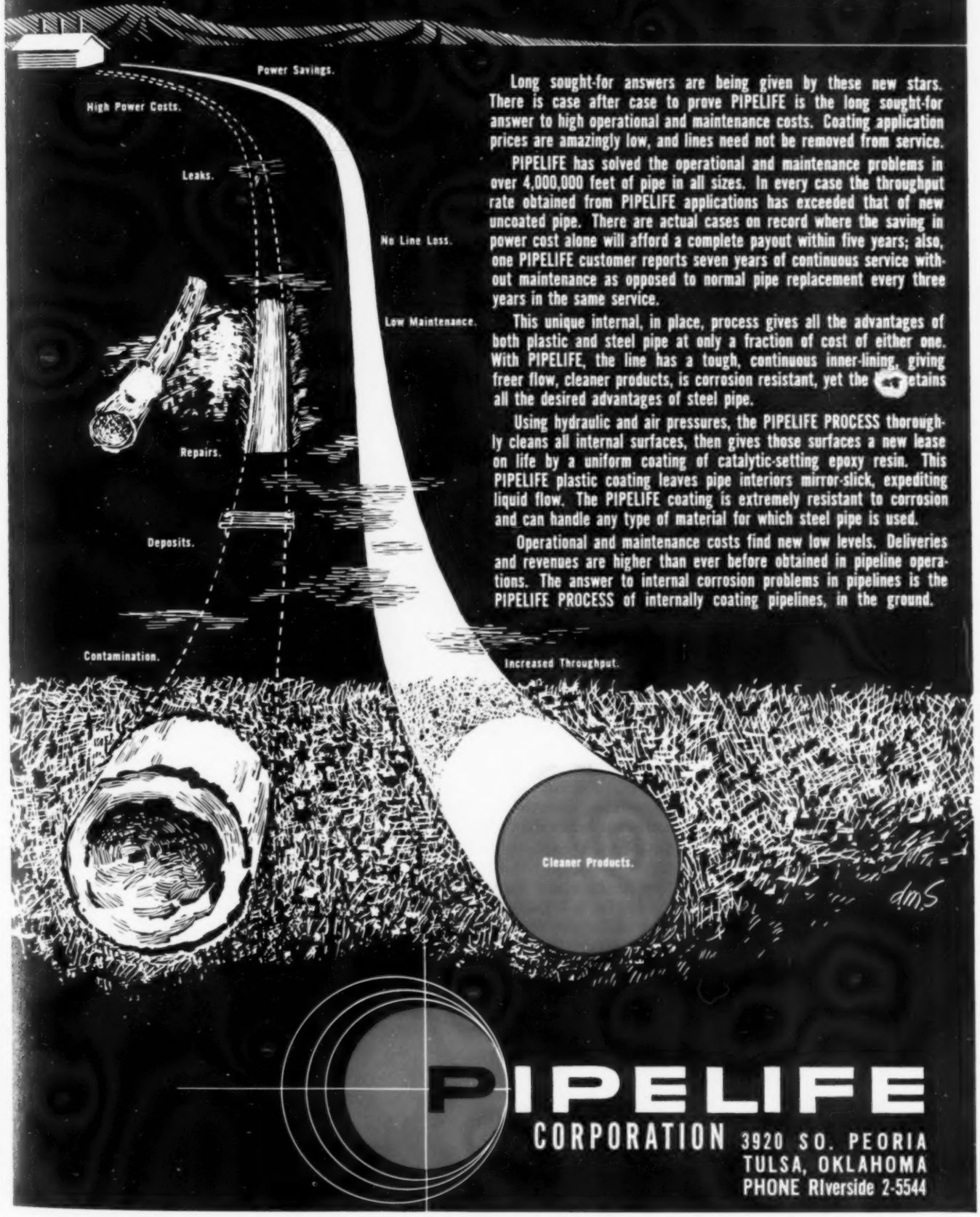
Call attention to lube oil pressure drops by fitting this air horn directly to the system. The horn is connected to the filter of a pressure lubrication system and to a source of compressed air.

As long as the pressure is at the required point, all is quiet—however,

TWO STARS BEGIN TO SHINE

PIPELIFE PLASTICS

ATOMIC ENERGY



Long sought-for answers are being given by these new stars. There is case after case to prove PIPELIFE is the long sought-for answer to high operational and maintenance costs. Coating application prices are amazingly low, and lines need not be removed from service.

PIPELIFE has solved the operational and maintenance problems in over 4,000,000 feet of pipe in all sizes. In every case the throughput rate obtained from PIPELIFE applications has exceeded that of new uncoated pipe. There are actual cases on record where the saving in power cost alone will afford a complete payout within five years; also, one PIPELIFE customer reports seven years of continuous service without maintenance as opposed to normal pipe replacement every three years in the same service.

This unique internal, in place, process gives all the advantages of both plastic and steel pipe at only a fraction of cost of either one. With PIPELIFE, the line has a tough, continuous inner-lining, giving freer flow, cleaner products, is corrosion resistant, yet the [illegible] retains all the desired advantages of steel pipe.

Using hydraulic and air pressures, the PIPELIFE PROCESS thoroughly cleans all internal surfaces, then gives those surfaces a new lease on life by a uniform coating of catalytic-setting epoxy resin. This PIPELIFE plastic coating leaves pipe interiors mirror-slick, expediting liquid flow. The PIPELIFE coating is extremely resistant to corrosion and can handle any type of material for which steel pipe is used.

Operational and maintenance costs find new low levels. Deliveries and revenues are higher than ever before obtained in pipeline operations. The answer to internal corrosion problems in pipelines is the PIPELIFE PROCESS of internally coating pipelines, in the ground.

PIPELIFE

CORPORATION 3920 SO. PEORIA
TULSA, OKLAHOMA
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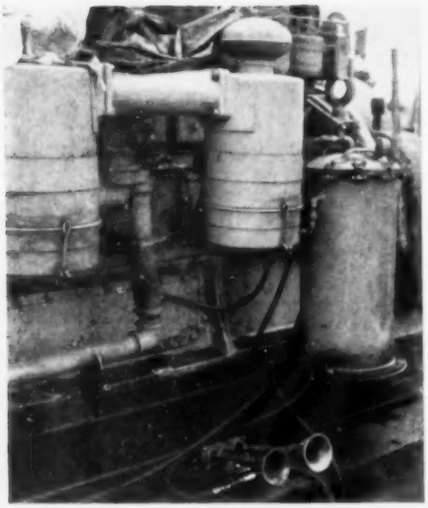


a drop in pressure unbalances the valve controlling the compressed air, sounding the horn. An allowable amount of drop can be pre-set on the valve. When pressure drops below this level, the warning blast alerts the operator.

Make Rack to Store Small Pipe at Station

This economical rack was made from scrap pipe for storing small diameter pipe at a compressor station.

Have a welder make the base and vertical supports by blanking off the ends of the scrap pipe with ¼-inch plate. The brackets may be spaced to store the desired amount of various sizes of pipe.

In addition to having the pipe easily accessible, the station area is kept free from random pup joints of pipe.

BRADEN WINCHES ARE:

★ **SAFE:** Up to 50% more reserve pulling and holding power than ratings indicate.

★ **STRONG:** Engineered for ruggedness. All moving parts, such as worm gears, made of steel and bronze alloy.

★ **GUARANTEED:** All BRADEN "M" Series Winches are guaranteed against defective workmanship & material for 1 year from date purchased.

BRADEN Truck Winches are engineered with as much care as many more complicated machines. Special alloys make them lighter but special engineering combines minimum dimensions with maximum strength.

Sure-action controls and the patented Oil-Cooled, Fully Automatic Safety Brake make the operator's job easy and safe. Longer, dependable service under the most strenuous conditions make BRADEN your best truck winch buy.

See Your BRADEN Dealer or Write for Complete Catalog

BRADEN WINCH COMPANY

P. O. Box 547, Broken Arrow, Oklahoma

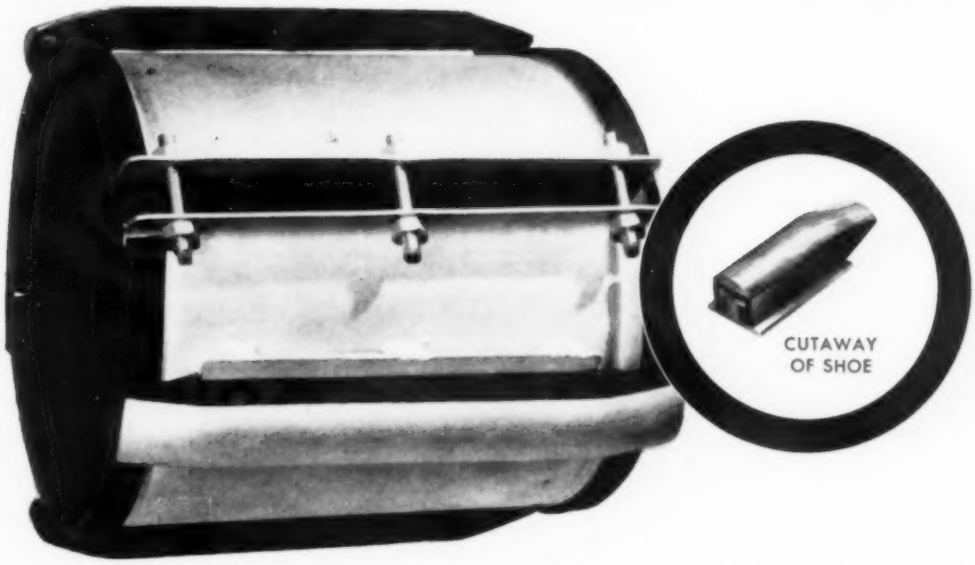
BRADEN Winches

Make Storage Locker To Protect Welding Rods

Make this convenient storage space out of a short pup-joint to keep welding rods and perishable materials dry and out of the way on a construction job.

Merely throw the locker up on the supply skid and the surplus supplies are in no danger of being misplaced or injured, and are readily available when needed. The hinged door drops down for quick access.

Model 55 Maloney Insulators for LARGE JOBS



Model 56 Maloney Insulators for Small Jobs

Maloney Insulators for *Every Job!*

Maloney Crossing Insulators for pipeline casing are exceptionally rugged, easy-to-install . . . *and adaptable to a wide range of pipe sizes and differentials.*

Because they are bonded metal-to-neoprene-to-metal, Maloney Insulators provide good shock-absorption, plus flexibility to compensate for pipe shifting.

Streamlined "sled-type" steel runners make for easy entry into the casing, and prevent hanging-up on casing welds as pipe is being run.

Model 55 Maloney Crossing Insulators, in all sizes through 36", are fitted with an extra-wide steel band for positive grip. Model 56, for pipe sizes through 12" with 2" nominal pipe size differential, are fastened to the carrier pipe with stainless steel bands. Both types offer greater dependability—greater protection against corrosion with high dielectric strength neoprene, and against physical damage with steel runners—than any other insulator on the market. Maloney Crossing Insulators are in use on most of the country's major pipelines.

"Something from the Irishman"

F. H. MALONEY *Company*

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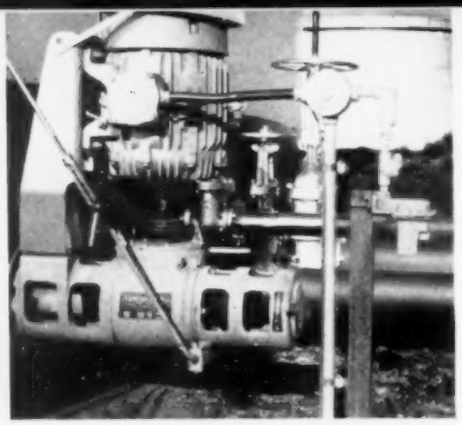
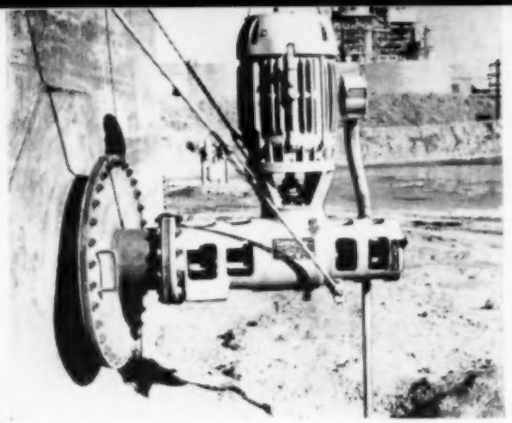
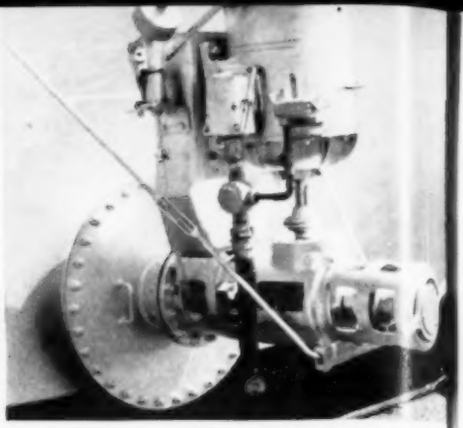
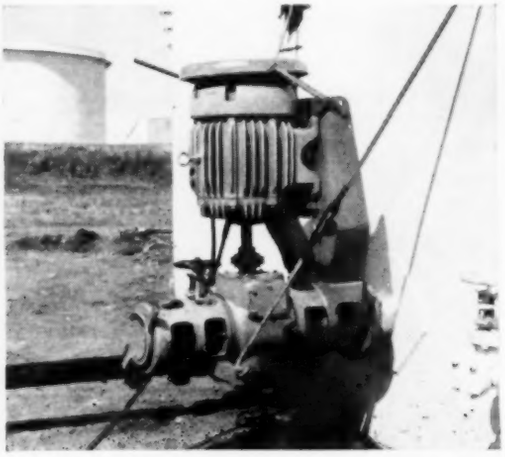
SINCE 1932 — PRECISION IN RUBBER — METAL — PLASTICS



YOU CAN GET LIGHTNIN MIXERS for controlling bottom sediment in any tank, regardless of capacity.

How 50 pipe line companies keep tank bottoms clean . . . **by pressing a switch**

More than 50 independent pipe line companies, and some 35 leading producers and refiners, have found an easy way to say good-bye to sludge cleanout costs in crude storage tanks.

Uniform crude; no sludge pile-up; dramatic savings—these are the results when you control sediment by flipping the switch on a LIGHTNIN Mixer.

Saved: $1,000 per tank per year

If your tank cleaning costs are about average, you lose from $5,000 to $8,000 every time you clean out an 80,000-barrel tank. These cost figures include a conservatively estimated $2,000 in marketable oil and wax lost in the bottoms. Often, this loss runs much higher—as high as $6,000 in some cases.*

When you install LIGHTNIN Mixers, you eliminate sludge buildup for good. You can keep sediment suspended in the crude, or resuspend it if it has settled. You can blend crude stocks to prevent stratification, and to dispatch a uniform crude.

Savings, overall, are on the order of $1,000 per tank per year.

As a bonus, you keep full holding capacity of your crude tanks ready for use when you need it. You gain as much as 12% more storage capacity —without adding a single tank.

Your LIGHTNIN Mixer representative can tell you how much *you'll* save with LIGHTNINs in your crude storage tanks. Look him up in Composite Catalog and call him in. Or write us direct.

*Based on field studies by a major pipe line company. Details on request.

"Lightnin® Mixers"

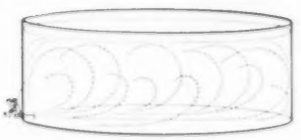
MIXCO fluid mixing specialists

Get these helpful bulletins on BS & W control and LIGHTNIN Mixers. Check, tear out and mail to us today with your name and company address. Free—no obligation.

- ☐ B-503 BS & W Control with LIGHTNIN Mixers
- ☐ B-104 Side entering mixers, 1 to 25 HP
- ☐ B-107 Data sheet for figuring mixer requirements
- ☐ B-109 Condensed catalog describing LIGHTNIN Mixers —all types
- ☐ B-111 LIGHTNIN rotary mechanical seals for extra-low-cost mixing

MIXING EQUIPMENT Co., Inc., 196-c Mt. Read Blvd., Rochester 11, N.Y.

In Canada: Greey Mixing Equipment, Ltd., 100 Miranda Avenue, Toronto 10, Ont.



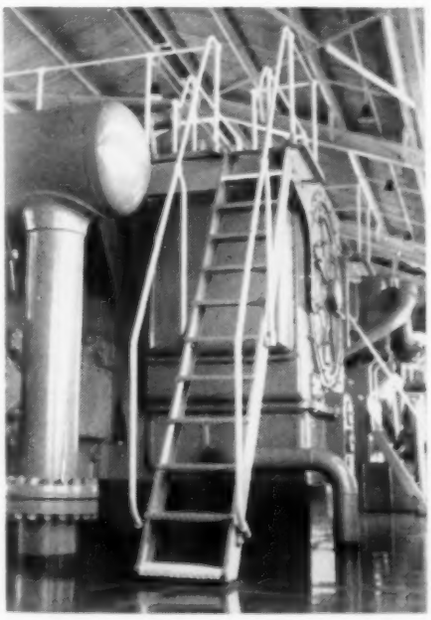
YOU CAN MAINTAIN bottom sediment level of as little as one inch, year after year with LIGHTNIN Mixers in your tanks.

Speed Valve Seat Removal With Shopmade Tool

To remove stuck compressor valve seats, a simple but effective tool may be made up in the shop. All that is required is a circular plate of 3/8-inch steel, two 3/8 by 8-inch steel bolts and nuts and washers. The plate has a slot 3 5/8 by 1/2-inch, cut into it.

Screw the long bolts into the valve seat, and place the circular plate over the bolts so that they extend through the slot in the plate. With the plate resting on the compressor, place washers and nuts on the bolts and tighten equally. After the nuts begin to bear on the washers, further tightening will cause the bolts to move through the nuts and washers, extracting the valve seat with the same motion.

This method is a great deal simpler than old methods of using a chain hoist or a brass bar and sledge hammer to remove stuck valve seats.



Painted Handrails Are Safety Aid Atop Engine

Brightly colored handrails atop a compressor engine can be a valuable safety aid under ordinary conditions. They are especially worthwhile during

BRANCH
after
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after
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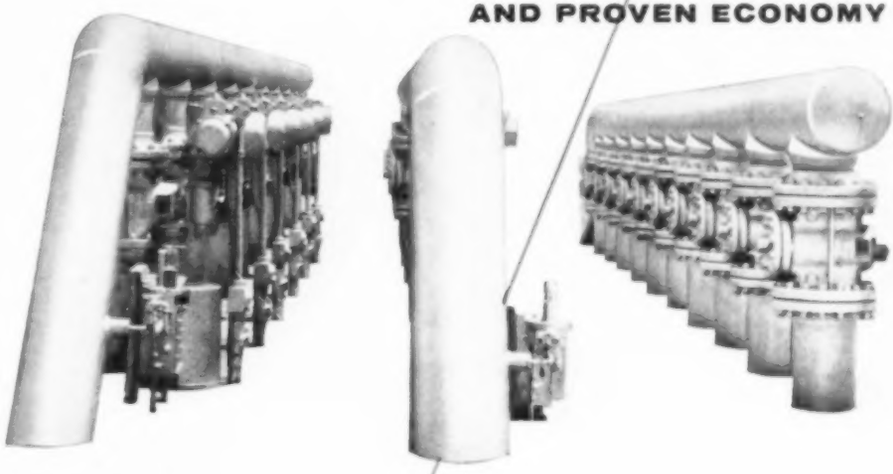
BRANCH

WELDOLETS

FOR ASSURED STRENGTH
AND PROVEN ECONOMY



WELDOLETS

THREDOLETS

SOCKOLETS

Are you effecting this economy for your company? Neat and uniform appearance is evident in code constructed weldolet headers in this crude oil pipeline terminal. The money saved is in the bank and does not appear in this picture. If you are not using the weldolet method of cutting piping costs, write today for information.

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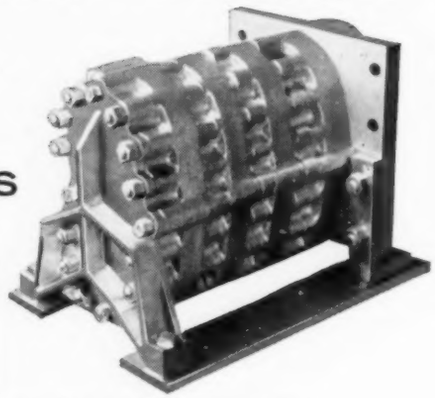

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- *for flexible speed*
  Full power output at infinitely variable speeds.
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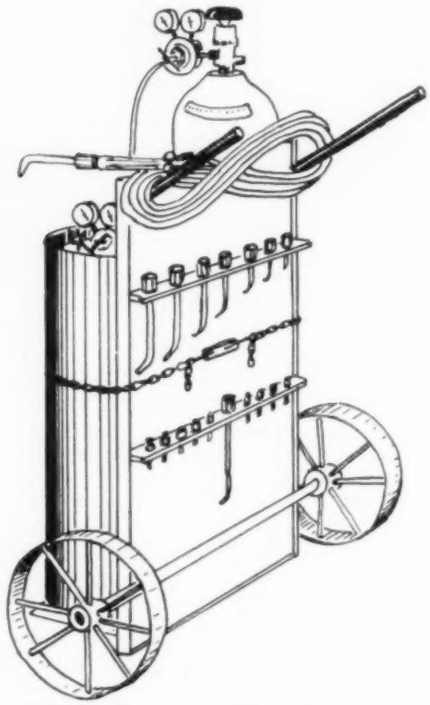
conditions of poor visibility such as a light failure. The station shown has all rails on top of the engine and along the ladders painted yellow in contrast with the dull gray of the machinery.

The top and bottom steps on the ladder, also considered critical locations, are painted yellow.



Make Burning Rig Dolly Out of Scrap Material

Help the welder who has a variety of welding and cutting jobs by building this convenient dolly. Work around a large shop or compressor station often calls for several size welding or burning tips on one job. The dolly shown here has a chain and turnbuckle to hold the tanks; while two strips of scrap metal with holes burned in them will hold the spare welding and burning tips. Scrap re-enforcing steel is used to build a rack for the hoses when not in use.

A complete editorial index covering all issues of PIPE LINE INDUSTRY published during 1956 has been compiled and bound separately in convenient pamphlet form. It will be sent free to all subscribers requesting copies.

To get your copy, address orders to the Librarian, Gulf Publishing Company, Post Office Box 2608, Houston 1, Texas. Or if you prefer, you can use the convenient Readers' Service Blue Postcard on the last page of this issue. Just check the square indicated. Fill in your name and address. Drop the postage-paid card in the mail, and the index will be sent you.

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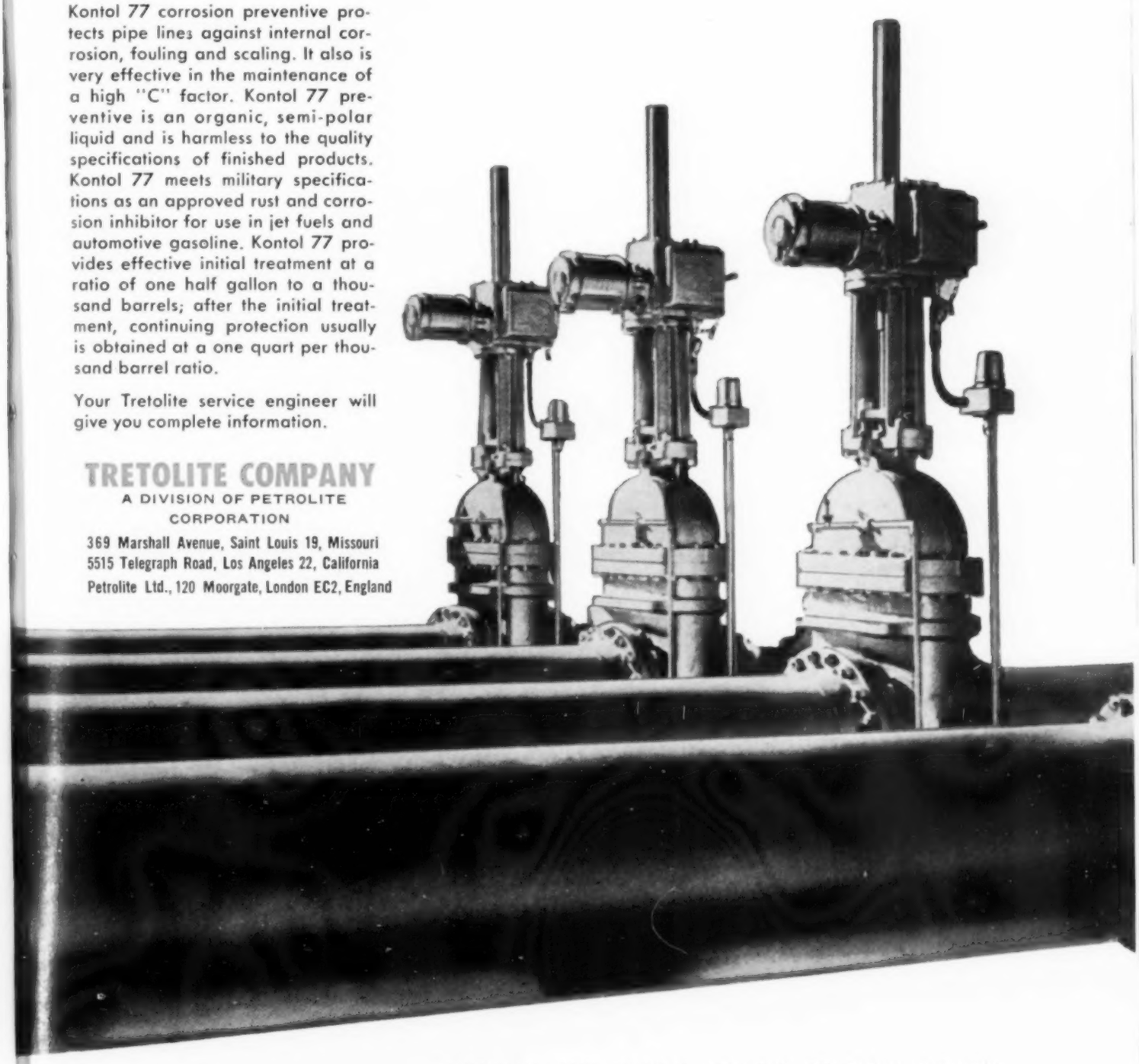

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MFL 565

Pipe Line Men

IN THE NEWS

James P. Neill

R. P. Gregory

M. S. Williams

Robert D. Sheehan

Officers of the **Pipe Line Contractors Association** elected at the recent meeting in Boca Raton, Fla., are **James P. Neill**, Western Constructors, Dallas, president; **R. P. Gregory** Houston Contracting Company, Houston, first vice president; **M. S. Williams,** Panama-Williams Company, Houston, second vice president; and **Robert D. Sheehan,** Sheehan Pipeline Construction Company, Tulsa, treasurer.

Newly elected directors include **C. C. Bledsoe**, Mid-Western Constructors, Tulsa; **Robert A. Conyes**, Conyes Construction Corporation, San Pablo, Calif.; **Gregory** of Houston; **E. G. Morrison**, Western Pipeline Inc., Austin, Texas; and **James W. Sharman,** Sharman, Allen Gay & Taylor, Houston. Continuing on the board of directors are **Jack S. Gray,** Grayco Constructors, Inc., Austin; **G. A. Manuel**, Williams-Austin Company, Pittsburgh, Penn.; **Neill** of Dallas, **Kenneth A. Owen**, Parkhill Truck Company, Tulsa; **Sheehan** of Tulsa, **John H. Williams**, Williams Brothers Company, Tulsa; and **M. S. Williams** of Houston.

•

Commonwealth Oil Company has re-elected its board of directors including **G. Burton Liese** of Houston, president, and **Byron L. Ramsing**, of Palm Beach, Fla., chairman of the board. Directors from Houston in addition to Liese are **W. Browne Baker**, John H. Blaffer, Harold Burrow and Alvin S. Moody. Miami directors include **Thomas H. Anderson** and **J. L. McCord**. Completing the list of board members is **Donald M. Lovejoy** of New York. Officers elected include **Liese**, president; **McCord,** executive vice president; **Robert C. Ledford** of Houston, vice president; **R. C. Kolbye** of Houston, treasurer, and **Howard M. Temple** of Houston, secretary.

•

Southern Pacific Pipe Lines Inc. has announced the appointment of **D. D. Lundgren** as acting chief clerk in San Francisco and **A. R. Winning** as materials coordinator in Los Angeles.

•

Oscar T. Leverenz has been elected secretary-treasurer of **Republic Natural Gas Company.** Leverenz formerly was audit manager of Arthur Andersen & Company in Dallas.

•

Plantation Pipe Line Company has announced several company personnel changes. **Robert C. Martin**, who has been acting as supervising engineer in the home office, is being transferred to an affiliate to fill an engineering assignment. Martin joined Plantation in 1946 on the Atlanta office engineering staff. He was assigned to valuation work in 1947, continuing in that assignment until he became cathodic protection engineer in 1948. **George M. Jeffares** takes Martin's place as cathodic protection engineer in Atlanta. Jeffares joined Plantation in 1947, assigned to the home office engineering staff in external corrosion protection work. Since then he has had temporary assignments as coating inspector on construction of the Baton Rouge-Charlotte line, and as cathodic protection foreman in the Eastern division.

•

Karl T. Feldman, Sinclair Pipe Line Company, Independence, Kansas, has been elected a member of the board of directors of **Platte Pipe Line Company.** Feldman succeeds **Angus A. Davidson,** Sinclair Oil & Gas Company and Sinclair Crude Oil Company, Tulsa, on the Platte board. Other members of the Platte board include **K. A. Covell,** The Pure Oil Company; **R. E. Kepke,** The British-American Oil Company; **W. L. Kygar,** Continental Pipe Line Company; **J. D. McConnell,** Sinclair Pipe Line Company; **Jack H. Rice,** The Ohio Oil Company; **W. G. Sexton,** The Toronto Pipe Line Company; **R. F. Sturgis, Jr.,** The Pure Oil Company; **T. A. van Griethuysen,** Continental Oil Company; **D. R. Williams,** The Ohio Oil Company; and **R. F. Moore,** Platte Pipe Line Company.

•

Walter E. Biery, general manager of **Mid-Continent Pipe Line Company**, has been elected a vice president. He succeeds the post vacated by **R. H. Wills**, now retired and formerly associated with D-X Sunray Oil Company, of which the pipe line company is a subsidiary. Wills remains a member of the Mid-Continent Pipe Line Company board of directors.

•

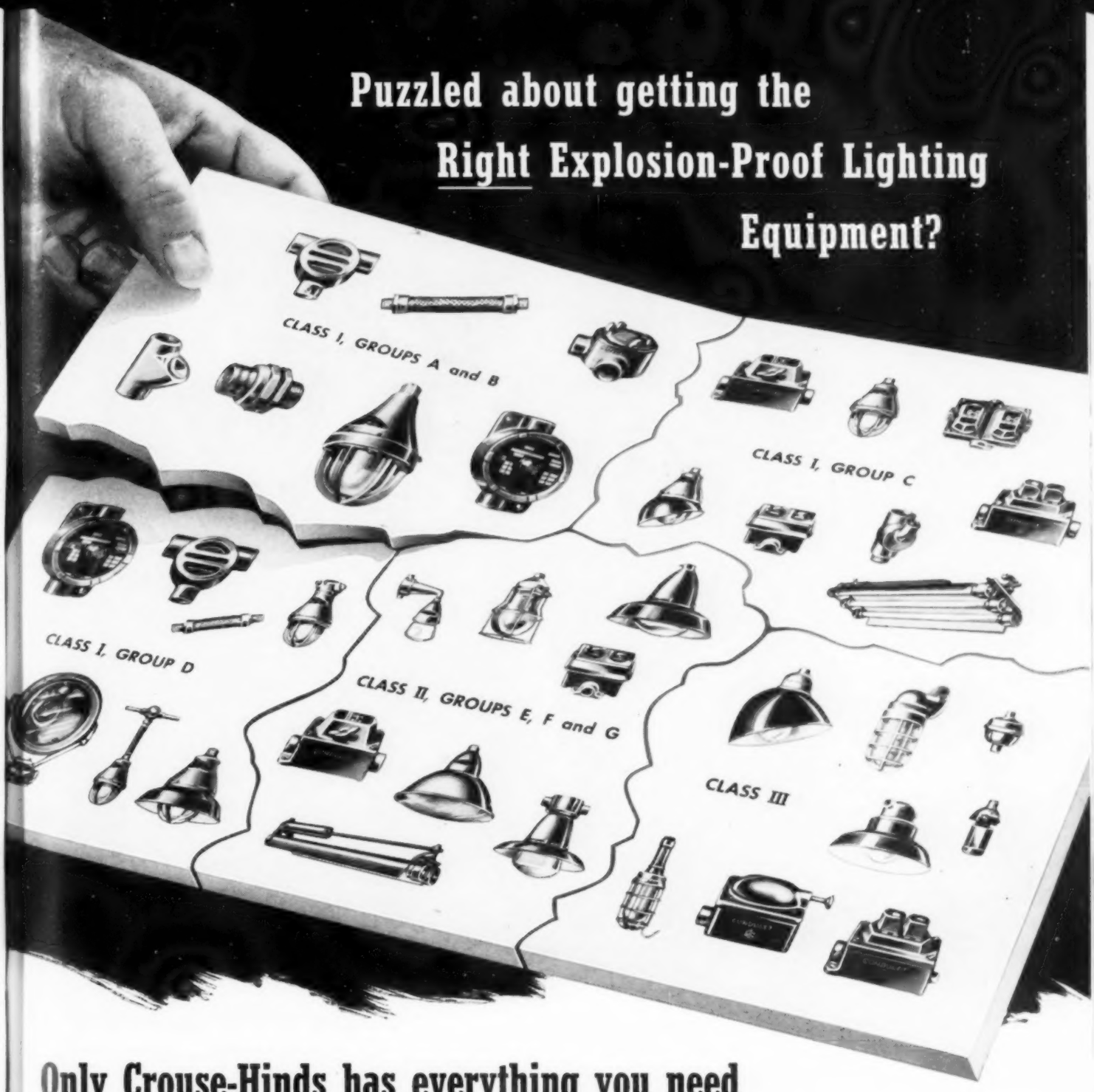
L. E. Ingham, vice president of **Texas Gas Transmission Corporation** and a member of the board of directors, has retired after more than 46 years in the natural gas industry. Ingham entered the natural gas industry in 1910 with United Natural Gas Company, Oil City, Penn. He gained experience in distribution, construction of pipe lines and compressor stations, and operation of large diameter pipe line systems with Iroquois Gas Company, Natural Gas Engineering Corporation, Columbia Engineering Corporation and Michigan Gas Transmission Corporation. Ingham joined Kentucky Natural as assistant to the president in 1939 and became vice president in 1943. He became vice president of Texas Gas Transmission Corporation in 1948 when Kentucky Natural Gas and Memphis Natural Gas were merged into Texas Gas.

L. E. Ingham

•

Houston Contracting Company has announced the promotion of **Earl C.**

Puzzled about getting the Right Explosion-Proof Lighting Equipment?



Only Crouse-Hinds has everything you need

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For *complete* protection when making lighting installations in hazardous locations you need more than explosion-proof or dust-tight lighting fixtures. You also need UL-listed explosion-proof switches, junctions, fixture supports, unions and seals.

Crouse-Hinds now offers a broad selection of Condulet* explosion-proof lighting equipment for Class I, Groups A and B locations. In fact, you can specify complete Crouse-Hinds explosion-proof lighting installations, all UL-listed, *no matter what class or group of Article 500 of the National Electrical Code is involved.*

The same holds true for the entire Crouse-Hinds Condulet line of more than 15,000 conventional and explosion-proof items. With the broadest line in the field, Crouse-Hinds recommends *exactly* what you need . . . and *only* what you need.

A nearby Crouse-Hinds distributor will be glad to discuss your explosion-proofing problems and make recommendations without obligation.

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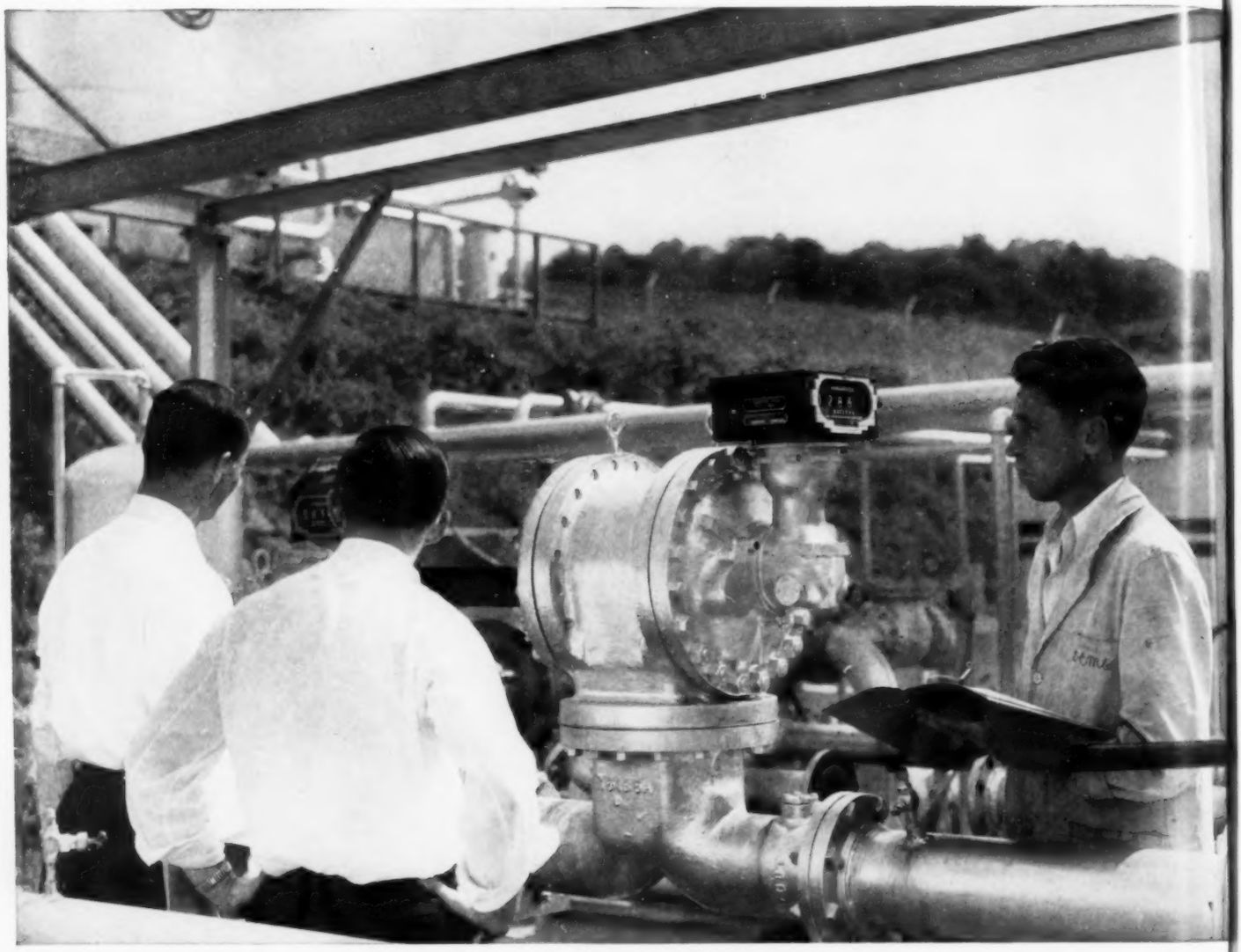
NEW ROTOR ASSEMBLY WITH



TESTED AND PROVED OVER A THREE YEAR SPAN

The superior performance of Rotocycle meters with the new crank controlled rotor has been thoroughly proved both in the field and at the Rockwell test station. The severity of these comparative tests included subjecting meters to operating conditions away beyond those normally encountered in actual use. Meters were run at accelerated rates, around the clock, on high temperature fluids and with much start and stop strain.

Thus we know and you can be sure that Rotocycles with this advanced design will give excellent performance, longer life and with less maintenance on all liquids that can be metered.

Rockwell Rotocycle meters with crank control are now in production—ready to go to work profitably for you. Write for new bulletin OG-411.

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SIMPLE CRANK CONTROL

Now Available In

ROCKWELL *ROTOCYCLE* METERS

Rockwell engineers have perfected a simple, coordinated linkage method to control the vanes in Rockwell Rotocycle meters. The new design does not alter the proven floward principle of operation. It does enhance performance and offer

All These Advantages

INCREASED CAPACITY Through reduced friction and improved balance, the new rotor design provides approximately 20% greater capacity (depending on size).

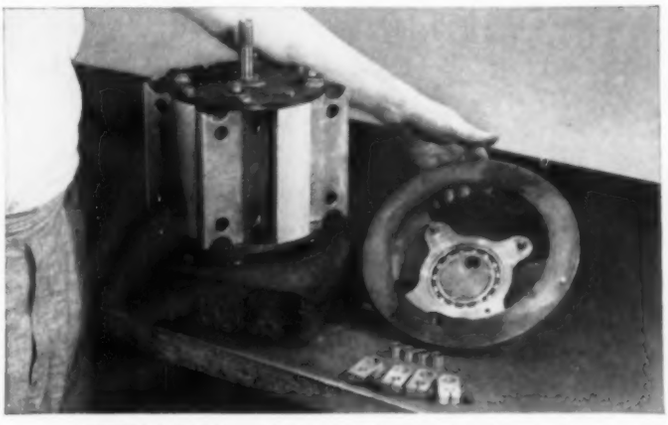
FEWER PARTS mean easier maintenance and longer meter life. And this new rotor assembly is *interchangeable* with earlier model rotors now in service.

PERMANENTLY TIMED There is only one possible way to assemble the new vane control parts and once assembled the vanes are *permanently* timed.

QUIET OPERATION This new balanced crank and link construction runs smoothly, operates silently.

EASIER IDENTIFICATION Rockwell Rotocycles are now numbered according to their capacity within normal operating range. For example, the most commonly used bulk plant and pipe line sizes are now designated No. 400, No. 600 and No. 1000 to code them to their ratings.

NEW ROTOR ASSEMBLY—Note simple, clean construction in the rotor control area.



FEWER PARTS, with simple linkage controls, sturdy bearings combine to produce greater flow rates and a long life of sustained accuracy.

READILY INTERCHANGEABLE with meters now in service. Conversion kits are available for all earlier Rotocycle meters to facilitate "on the job" changeover.

Norris to general superintendent of field operations. Norris has been with Houston Contracting Company for 20 years, serving as spread superintendent for the past 17 years.

•

Nelson M. Lytle, former master mechanic with **Interstate Oil Pipe Line Company,** has been named to the newly-created position of assistant superintendent of the company's Sunset, La., district. Lytle will be assistant to **G. C. Rives,** district superintendent. In 1950 Interstate granted Lytle a year of absence to serve as chief inspector of pump station construction in Canada for Interprovincial Pipe Line Company. In this capacity he supervised construction of pipe line pump stations at Regina, Saskatchewan, and Cromer and Gretna, Manitoba. Lytle has more than 28 years of service, having served as pump repairman, machinist, chief mechanical foreman and assistant master mechanic. He was named master mechanic in 1955.

•

Robert M. Woolfolk, Jr. has joined **Texas Gas Corporation** as chief engineer. Woolfolk's headquarters will be at the Houston general offices of Texas Gas. Before becoming associated with Texas Gas, Woolfolk held a similar position with The California Company.

•

Walter E. Jennings, executive vice president and member of the board of directors of **The Buckeye Pipe Line Company,** has retired after completing 48 years of service. First employed in 1908 as a telegraph operator at the Saddle River, N. J., station of the New York Transit Company, Jennings was transferred to the New York office of Buckeye in 1922 and held various positions in the Oil Traffic department, including department manager. He was elected vice president in 1950 and executive vice president in 1954.

Walter E. Jennings

•

J. D. Davis, Shreveport, has been appointed assistant to **Ed Parkes** of **United Gas Pipeline Company** and **Union Producing Company** and executive vice president of **United Gas Corporation**. Davis, who has more than 32 years service with the United Gas organization and its predecessor companies fills the post formerly held by **D. D. Dillingham, Jr.,** recently promoted to executive vice president of United Gas Pipeline Company. Before coming to Shreveport with United Gas to become superintendent of the firm's western pipe line division, Davis was district manager in charge of pipe line and producing operations of the company in its Jackson, Miss., district. Before his assignment as district manager at Jackson, Davis filled other supervisory positions with United Gas.

•

Elwood Kisby has been named president of **Michigan-Ohio Pipeline Corporation**. Kisby, vice president of Michigan-Ohio since 1953, succeeds **Charles A. Schrader**, who recently resigned from Michigan-Ohio to become vice president of supply and transportation at Leonard Refineries, Inc. Kisby, a director of the company, has been in the pipe line business since 1937, when he joined the

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'Dry-Air GAS
GRAVITOMETERS
This new Arcco-Anubis Dry Air Gas Gravitometer determines and records specific gravity of gases automatically corrected to the humidity content of the air. The difference in weight between a column of GAS and equal column of DRY AIR is measured. This ratio represents the true specific gravity of the sample.
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- Two speed travel (optional)—.8 M.P.H. and 1.6 M.P.H.
- Increased stability and flotation with 12′6″ crawlers and 24″ or 30″ shoes
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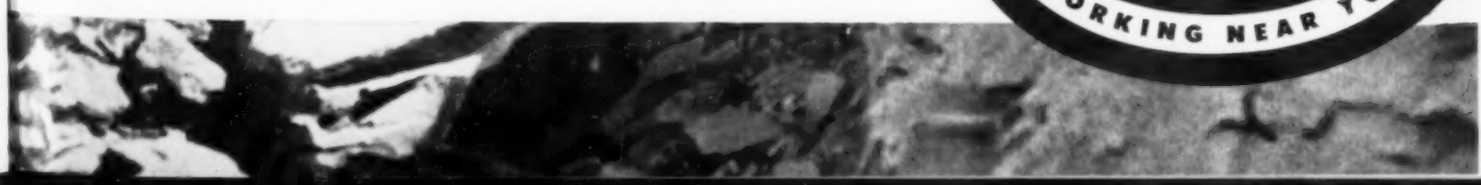

New Water Line, which will treble present supply to Lenoir, N. C., consists of 50-foot lengths of steel pipe, lined and coated with Bitumastic No. 70-B AWWA Enamel. The Koppers Contract Coating Department set up complete field cleaning, lining and coating facilities at the job site. Coal-tar enamel linings are the only type allowed in the recommended specifications of the American Water Works Association. Coal-tar coatings are the only materials which field experience has proved can resist water and provide high electrical resistance over long periods of time.

Extra Life given this warehouse through the protection of Bitumastic coatings has been estimated at 10 years. The all-metal structure was cleaned completely by power and hand wire-brushing, then coated with a system using Bituplastic® No. 28, a sunlight-resistant coal-tar coating. A coat of aluminum paint on the building's lower portions completed its fresh appearance.

This New Bulletin outlining the useful scope of Bitumastic protective coatings is now available. You'll find it a handy guide in the selection of corrosion-resistant coatings for your applications. Write for your copy today: Koppers Company, Inc., Tar Products Division, 1450 Koppers Building, Pittsburgh 19, Pa.

how to
CUT CORROSION LOSSES
a report by Koppers Company, Inc.

Number 7 of a series

F. P. Filer
Project Leader

In this Corrosion Report, we would like to explore the functions of primers and the contribution which they can make toward the success of protective coating systems. While every step in a protective coating system is important, from precoating survey to finished coating, one of the more important is priming.

* * *

Basically, primers have one specific function: to bond intermediate and finish coats to the metal surface. To perform this function properly, it is vitally important that the primer be compatible with the intermediate and finish coats.

* * *

While priming is used with most protective coatings—with the exception of certain proprietary coal-tar coatings—no primer can compensate for incomplete surface preparation. The Steel Structures Painting Manual states specifically, "Any primer sold on the basis that it eliminates the preparation of the surface should be viewed with extreme caution." Rust, dirt, grease, and loose scale should *always* be removed before priming. In some cases, primers are applied over tight mill scale in the shop. Good practice would dictate removal of scale before priming to obtain a long-lived coating system.

We have often been asked whether shop primers (applied by the metal fabricator) should be used. One disadvantage is that they sometimes become badly scratched in transit and require considerable touch-up on the job site. Other drawbacks are that shop primers may not provide protection for a sufficiently long period, and may be applied without regard to their compatibility with the field coating specified. Also, shop primers may cover up inadequate surface preparation jobs.

The following points should be considered before specifying shop primers: (1) corrosivity at the job site; (2) estimated time between shop priming and field coating; (3) compatibility with the coating.

* * *

The terms "wash primer" and "primer" should not be confused. A wash primer is not a true primer but an integral part of surface preparation. It does not take the place of a primer when priming is required. Sometimes, wash primers are specified for short-term protection before application of self-priming, cold-applied coal-tar coatings.

* * *

From an application standpoint, there are three characteristics of primers that are of importance: wetting ability, consistency, and drying time. Properly selected and applied, primers should provide a uniform, tightly-bonded film to which the coating system will adhere tenaciously.

* * *

Your comments on these Reports will be appreciated. If there are any specific questions which you have relating to corrosion control, write Koppers Company, Inc., 1450 Koppers Building, Dept. 121C, Pittsburgh 19, Pa. District Offices: Boston, Chicago, Los Angeles, New York, Pittsburgh and Woodward (Birmingham) Ala. In Canada: Koppers Products, Ltd., Toronto, Ontario, and Edmonton, Alberta.

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For more data on advertised products, use Readers' Service Cards, last page.

Michigan-Toledo Pipeline Company as a station engineer. He moved to Sohio Pipeline Company in 1940 and in 1950 he joined Michigan-Ohio.

•

L. L. Whiteneck

W. H. Stewart

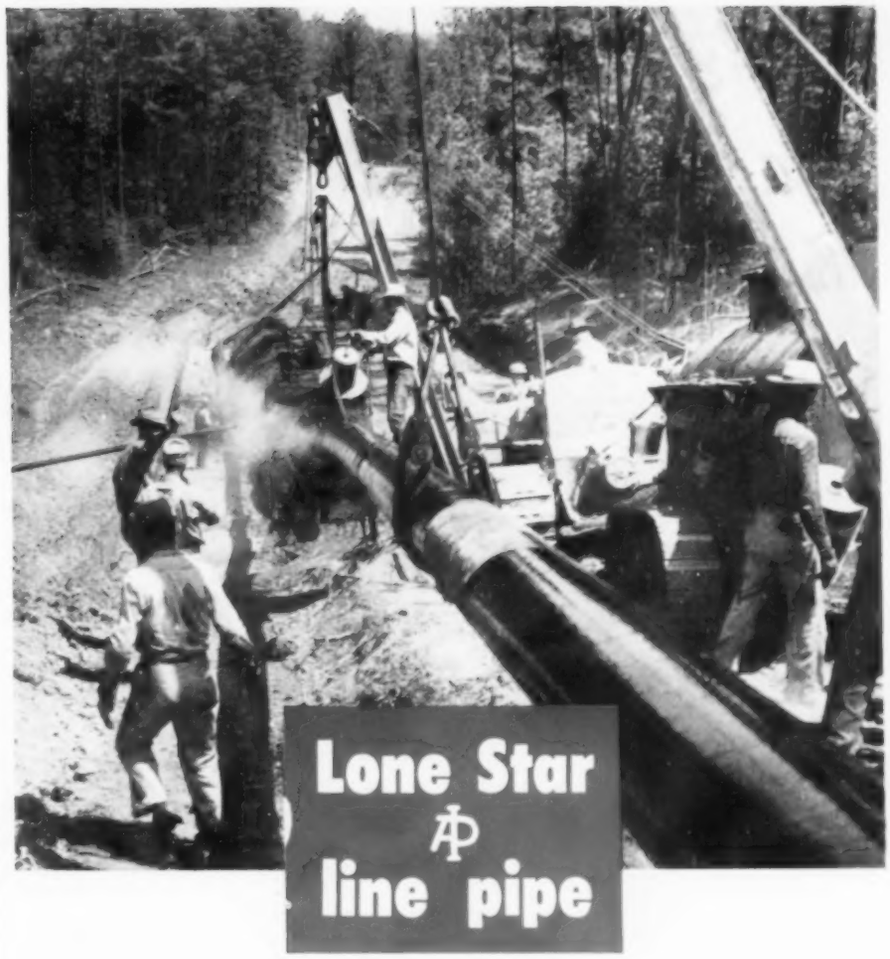
Officers of the **National Association of Corrosion Engineers** for 1957 who will take office at the meeting in St. Louis in March are **W. H. Stewart,** president; **L. L. Whiteneck,** vice president; and **A. L. Stegner,** treasurer. **A. B. Campbell** is re-elected executive secretary.

A. L. Stegner

Stewart, a member of the original group of pipe line engineers who formed the Mid-Continent Cathodic Protection Association, and now corrosion engineer for the Crude Line division, Sun Pipe Line Company, joined Sun Oil Company in 1929 and Sun Pipe Line Company in 1934. He was elected to the NACE board in 1955 and vice president in 1956. Whiteneck, vice president and director of corrosion control for Plicoflex, Inc., Los Angeles, formerly was senior harbor engineer for the Long Beach, Calif., harbor department in charge of testing, evaluation and corrosion design. Whiteneck has been an official of Western Region of NACE and was a member of the board of directors. Stegner, director of the corrosion control program and Radio Communications department of Tennessee Gas Transmission Company, has been a member of the NACE board of directors for the past year. He has been with Tennessee Gas since 1946, when he returned from service. Prior to that he worked in power transmission and distribution engineering.

•

A. Carl Gladden, vice president and treasurer of **Texas Gas Corpora-**



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The huge, ultra modern Lone Star Steel plant was built primarily to serve the busy Mid-Continent area . . but week after week, pipe orders come in for tons of Lone Star API line pipe, casing and tubing to be used in distant territory.

From mining of the ore through Lone Star's precision pipe mills..Lone Star's API pipe quality is controlled in every step of manufacture. Lone Star line pipe has uniform wall thickness and roundness, is easy to field weld and easy to bend.

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Use Power Tools Everyplace with HOMELITE Carryable GENERATORS

You can be miles from the nearest power line and still save time, labor and money with modern electric tools. You do it with Homelite Carryable Generators.

Small and compact, a Homelite is easily transported anyplace . . . by jeep, by truck or by hand. And it will give you plenty of power . . . plenty of *dependable* power . . . for operating chain saws, floodlights, hand saws, drills, grinders or any other power hand tool, *both standard universal and high cycle.*

Look into Homelite Carryable Generators today. Send for bulletin showing all models available and many of their uses. Why not do it, now!

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tion, has been elected to membership on the board of directors, while **A. A. White,** secretary and general counsel, and **Dr. Willard M. Dow,** director of research, have been elected vice presidents. Dow is in charge of manufacturing, engineering and research. **Earl Elliott** of the Legal department has been elected assistant secretary. All other officers of Texas Gas were re-elected at the recent meeting of the directors.

•

Ray C. Fish of Houston has been named to the board of directors of **Transcontinental Gas Pipe Line Corporation.** Fish is chairman of the board of Pacific Northwest Pipeline Corporation and president of Fish Engineering Corporation. He has 30 years of oil and gas engineering and construction experience. Fish's engineering firm designed and constructed the original 1840-mile Transco line from Texas to New York.

Ray C. Fish

•

Ira O. Walker, president of **Fairfax Pipe Line Company,** has announced the change of name of the company to **American Oil Pipe Line Company.** It is a subsidiary of American Oil Company.

•

Charles A. Schrader has been named vice president for supply and transportation at **Leonard Refineries, Inc.** Schrader will be responsible for general purchasing, crude oil procurement, traffic, product orders, transportation and product exchange. Schrader first entered the Michigan oil business as vice president of Mid-West Refineries, Inc. in 1947. In 1950 he became president and a director of Michigan-Ohio Pipeline Corporation in Mt. Pleasant, Mich. He held that position until chosen for his new post by Leonard Refineries.

•

Gardiner Symonds, president and director of **Tennessee Gas Transmission Company,** has been elected to the board of directors of **Southern Pacific Company.** Symonds will succeed to the position formerly held by the late Everett L. DeGolyer of Dallas. Symonds is chairman of the Petro-Tex Chemical Corporation and of Bay Petroleum Corporation. He is president of Tennessee Products Pipe Line Company, subsidiary of TGT, and a director of Trans-Canada Pipe Lines, Ltd.

•

Republic Natural Gas Company has elected **Ralph S. Euler** and **Edwin L. Kennedy** to the board of directors and **C. D. Miller** has been appointed by the board as vice president of Republic Natural Gas. Euler, senior vice president, director and member of the executive committee of Mellon National Bank and Trust Company of Pittsburgh, is a veteran banker. He joined Union Trust Company of Pittsburgh in 1918 and served as vice president of the combined banking houses. Earlier Euler was associated with Federal Reserve Bank of Cleveland and Colonial Trust Company in Pittsburgh. Euler is also on the board of directors of Lone Star Gas Company and Shamrock Oil and Gas Corporation.

Kennedy, a partner of Lehman Brothers, New York, started his business career with Standard & Poor's, joining Lehman Brothers in 1941. He

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No change except the corporate name. We still have the same ownership, same management, same address, same telephone, and use the same 45 years of experience to render the same service under the same trade name—"PELCO."

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Full Line of Carryable Construction Equipment Now Offered by Homelite

Carryable Diaphragm Pump . . . This self-priming, 120 pound diaphragm pump will handle water in the thickest sand, muck, or mud. Capacity: 5,000 g.p.h. Size: 3". Complete line of centrifugal pumps are also available in sizes from 1½" to 3".

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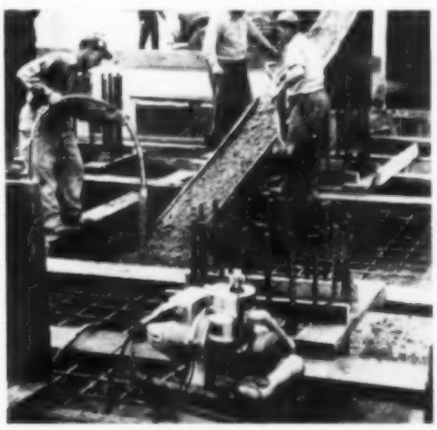

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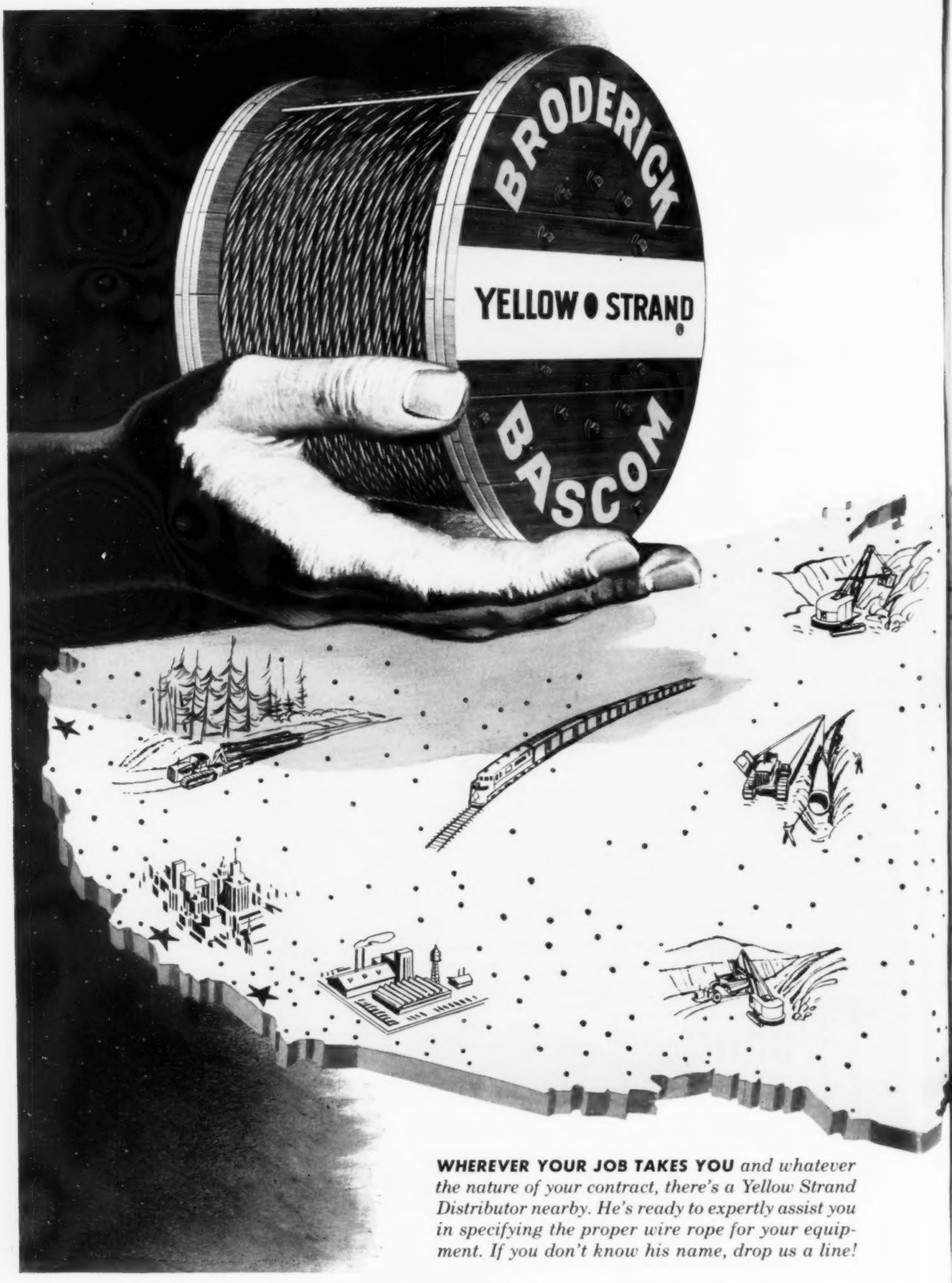

WHEREVER YOUR JOB TAKES YOU *and whatever the nature of your contract, there's a Yellow Strand Distributor nearby. He's ready to expertly assist you in specifying the proper wire rope for your equipment. If you don't know his name, drop us a line!*

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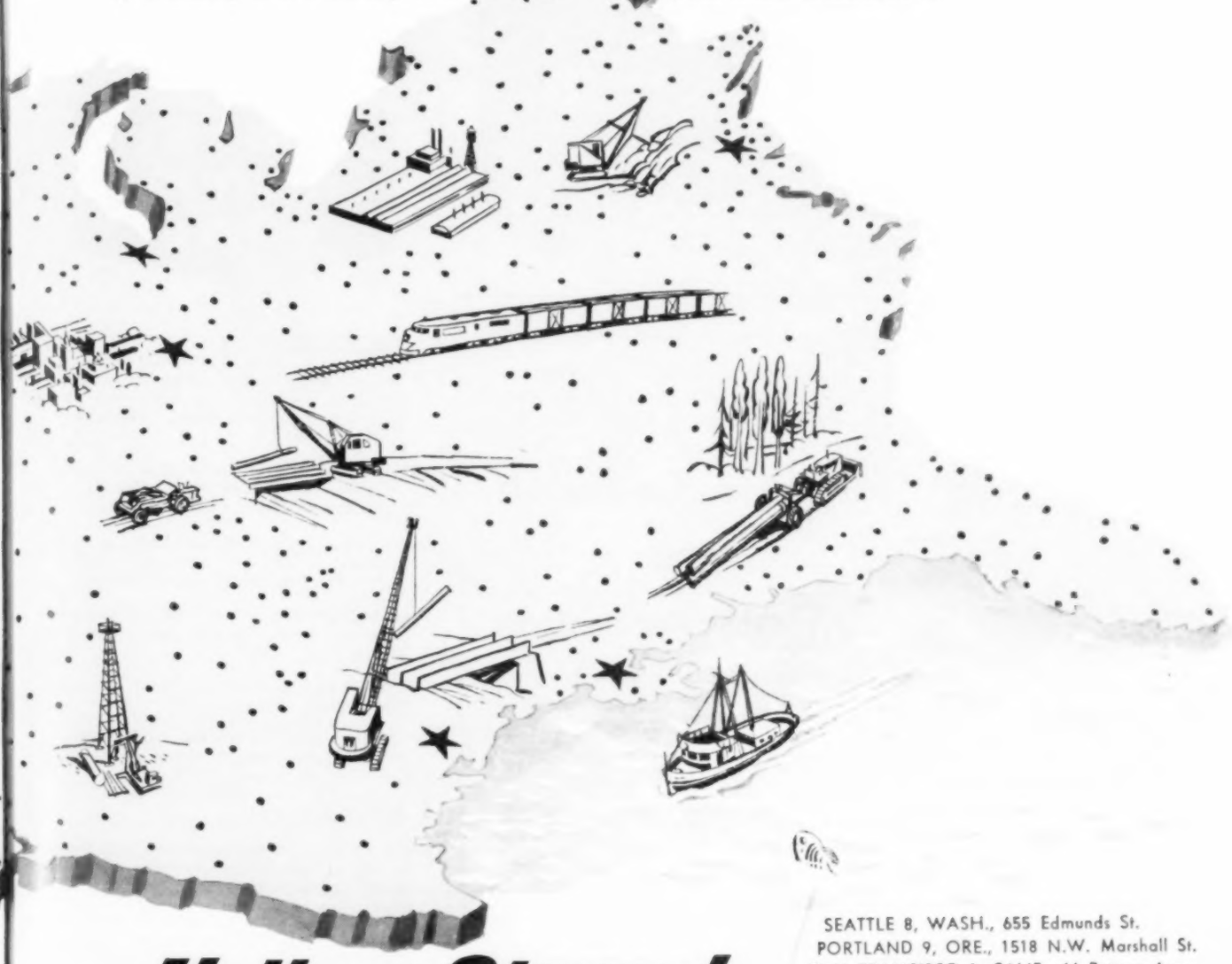
You can be *sure* of good performance when you use Yellow Strand "POWERSTEEL" and Yellow Strand Flattened Strand Wire Ropes —and *doubly* sure when they're backed by your B & B Distributor.



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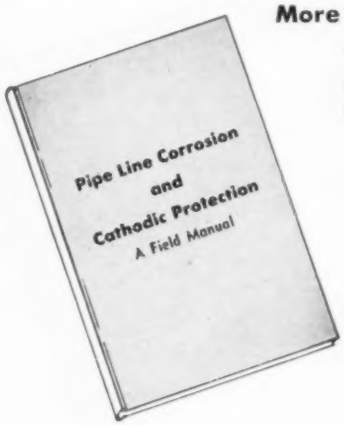
More comments on this new Handbook:

"... a most practical on-the-job manual for men concerned with pipe line corrosion. We are ordering copies for each of our district engineers."



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This Handbook, written by Marshall E. Parker, consultant, is designed as a practical field manual. It is a 108-page pocket-size volume printed first as a popular series in WORLD OIL. The Handbook is illustrated with many charts and drawings and is completely indexed by subjects.

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also serves on the board of Kerr-McGee Oil Industries, Inc., Murphy Corporation, Gas Properties, Inc., Distillate Production Company, and the Independent Petroleum Association of America.

Miller started with Barnsdall Oil Company in 1927. He advanced through the Engineering and Production departments and remained with Barnsdall until 1942, reaching the position of general superintendent of production. Miller joined British-American Oil Producing Company as vice president in charge of production, later becoming executive vice president in charge of exploration and producing operations. Leaving British-American in 1953, Miller joined the Harper-Turner Oil Company as executive vice president, where he remained until his present appointment.

WHO'S MEETING WHERE

March

American Society of Photogrammetry, American Congress on Surveying and Mapping, Shoreham Hotel, Washington, D. C., March 3-9.

NACE, 13th Annual Conference and Exhibition, Kiel Auditorium, St. Louis, Mo., March 11-15, 1957.

ASME, Gas Turbine Power Division, 2nd National Conference, Sheraton Cadillac Hotel, Detroit, Mich., March 18-21.

New England Gas Association, Annual Meeting, Hotel Statler, Boston, Mass., March 21-22, 1957.

Mid West Gas Association, Hotel Nicollet, Minneapolis, March 25-27.

American Society for Metals, 10th Western Metal Exposition, Ambassador Hotel, Los Angeles, March 25-29.

April

NACE, Central Oklahoma Section, and University of Oklahoma Corrosion Control Short Course, Univ. of Okla. Extension Study Center, Norman, April 2-4.

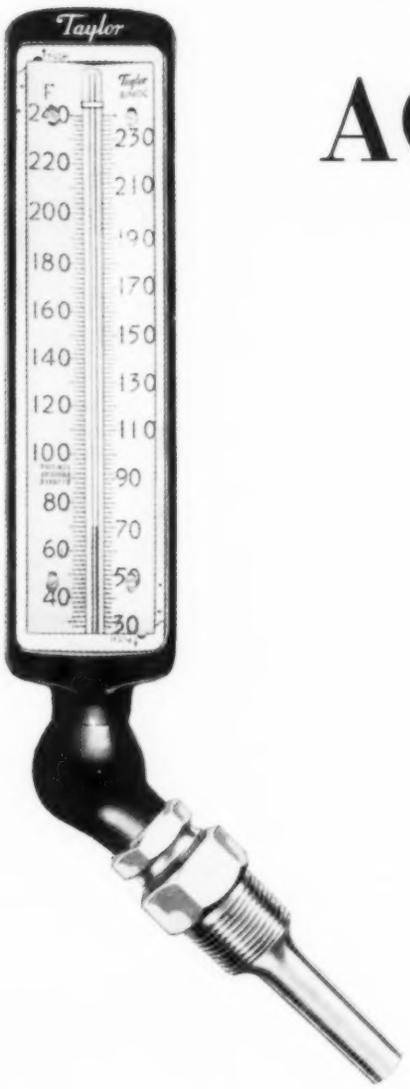
Petroleum Equipment Suppliers Association, Palm Springs, Calif., April 6-11, 1957.

Industrial Accident Prevention Association, Royal York Hotel, Toronto, Canada, April 8-9.

ASME, Spring Meeting, Hotel Dinkler-Tutwiler, Birmingham, Ala., April 8-10.

Continued on Page 106

2 ways to measure temperature ACCURATELY



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Exclusive Taylor BINOC* tubing makes these industrial thermometers three-times-easier-to-read. Extra bold black numerals stand out sharply on white background. Ask for **Catalog "E".**

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Accurate within ±1% of range, over entire range. No ambient temperature effect. Overrange protection 50% up to 500°F.; 10% above 500°F. Silicone damping in all instruments except 200° to 750°F. range results in increased speed of response, minimum pointer vibration and elimination of pointer chatter. Ask your Taylor Field Engineer, or write for **Bulletin 98267.** Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

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CALIBRATED DIAL
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ZINC PLATED STEEL CASE
OUTSIDE ADJUSTMENTS

FOR OUTDOOR SERVICE
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Weather Resistant
(Weather Proof)
(Splash Proof)
(Sleet Proof)
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Write for catalog No. 857W which also lists general purpose controls (NEMA 1) and explosion proof controls (NEMA 7, 9, 9A).

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AGA Distribution, Motor Vehicles and Corrosion Conference, Rice Hotel, Houston, April 8-11.

American Welding Society, Sheraton & Bellevue Stratford Hotels, Philadelphia, April 8-12.

Institute of Radio Engineers, 1st Annual Conference on Electronics in Industry, Illinois Institute of Technology, Chicago, April 9-10.

Petroleum Industry Electrical Association & Petroleum Electric Supply Association, 29th Annual Conference and Exhibits, Shamrock-Hilton Hotel, Houston, April 16-18.

Southwestern Gas Measurement Short Course, College of Engineering, University of Oklahoma, Norman, April 16-18.

National Petroleum Association, 54th Annual Meeting, Cleveland Hotel, Cleveland, April 16-18.

National Gasoline Association of America, 36th Annual Convention, Rice Hotel, Houston, April 24-26.

Independent Petroleum Association of America, Midyear Meeting, Buena Vista Hotel, Biloxi, Miss., April 28-30.

Southern Gas Association, Annual Convention, New Orleans, April 29-May 1.

May

4th Annual Conference for Engineers & Architects, College of Engineering, Ohio State University, May 3.

API Annual Pipe Line Conference, Cleveland Hotel, Cleveland, May 6-8.

Fluid Control Institute, Greenbriar, White Sulphur Springs, W. Va., May 8-11.

AGA-PCGA Gas Supply, Transmission and Storage Conference, Mark Hopkins Hotel, San Francisco, May 8-10.

API Safety and Fire Protection Committees, Hotel President, Kansas City, Mo., May 13-17.

ASME, 29th Annual Conference and Exhibit of Oil and Gas Power Division, Kentucky Hotel, Louisville, Ky., May 20-23.

June

Petroleum Electric Power Association, Annual Conference, Amarillo, Herring Hotel, June 3-5.

Appalachian Underground Corrosion Short Course, West Virginia University, Morgantown, W. Va., June 4-6.

ASME, Semiannual Meeting, Sheraton-Palace Hotel, San Francisco, June 9-13.

ASTM, Chalfonte-Haddon Hall, Atlantic City, N. J., June 16-21.

Michigan Gas Association, Grand Hotel, Mackinac Island, Mich., June 24-25.

American Institute of Electrical Engineers, Sheraton-Mt. Royal Hotel, Montreal, Canada, June 24-28.

September

National Petroleum Association, 55th Annual Meeting, Traymore Hotel, Atlantic City, N. Y., Sept. 11-13.

12th Annual Instrument-Automation Conference and Exhibit, Auditorium, Cleveland, Ohio, Sept. 11-15.

ASME, Fall Meeting, Mayo Hotel, Tulsa, Sept. 23-25.

October

Texas Mid-Continent Oil & Gas Association, 38th Annual Meeting, Texas Hotel, Fort Worth, Oct. 1-2.

NACE, North Central Region, Sherman Hotel, Chicago, Oct. 1-4.

NACE, South Central Region, City Auditorium, Oklahoma City, Oct. 1-4.

American Gas Association, Kiel Auditorium, St. Louis, Mo., Oct. 7-9.

AIEE, Morrison Hotel, Chicago, Oct. 7-11.

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Specify **"GOTKOOL"** the next time you order water cans or coolers. **"GOTKOOL'S"** exclusive construction keeps water cooler . . . fresher . . . purer. Extra wide, snug-fitting, splash-proof top keeps out impurities. Non-leaking, push-button faucets, either extended or recessed flush mounted. *Buy* **"GOTKOOL"** *at your supply store today.*

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Your pipeline operation is as efficient—and profitable—as its control communications system.

That simple fact emphasizes the importance of a properly designed system to insure unfailing reliability and flexibility for future growth.

Westinghouse fills the bill by providing the ultimate in circuit simplicity designed specifically for ease of maintenance and interchangeability. Multiplex panels allow up to 30 crystal-controlled channels capable of carrying up to 15 sub-channels for telegraph, teletype, telemetering or supervisory control. Westinghouse system design incorporates automatic alarm and *100% stand-by* for interruption-free service. Above all, Microwave gets through, without wires subject to weather or accident damage.

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AMONG SERVICE AND SUPPLY MEN

I. W. McKinney

Dan Smartt

3 Sales Representatives Join Frank Wheatley Supply

Three new sales representatives have been named by Frank Wheatley Supply Company to operate in Tulsa, Oklahoma City and Houston.

Jerre Waddock

Jerre Waddock, formerly field representative in Tulsa for Fairbanks-Morse, has joined Wheatley on the Tulsa staff. The Oklahoma City operation will be enlarged with the addition of Dan Smartt, Oklahoma City industrial supply man. I. W. (Dub) McKinney, formerly with Crutcher-Rolf-Cummings, has been named special representative in the Houston area.

Love to Represent Royston In Southeastern States

Royston Laboratories, Inc., announces the appointment of Harrison M. Love, Jr., as representative in the southeastern states, assisting the Atlantic regional sales manager, E. M. Steinmann.

Love is handling Roskote mastics and other Royston pipe line products as well as industrial protective coatings. He has had several years experience in the field of corrosion control in the southeast.

Donatic and Williams Named To Posts at Kaiser Steel Plant

Ernest F. Donatic was named general superintendent and James P. Williams appointed manager of engineering and planning at the Kaiser Steel plant at Fontana, Calif.

Formerly assistant general superintendent of services, Donatic will coordinate activities of the Iron and Steel, Rolling Mills, and Services divisions at the plant. He joined Kaiser Steel in 1946 as assistant superintendent of maintenance, following 23 years with Republic Steel, Chicago, where he had been assistant superintendent in charge of electrical maintenance and crane repair.

Williams, formerly assistant general superintendent, will have responsibility over plant engineering, metallurgy and inspection, industrial engineering and production planning. Williams came to Kaiser Steel as chief industrial engineer in 1945 from Geneva Steel, Utah, where he had been plant industrial engineer.

Kearns Named District Manager Of Bristol Sales Office

John E. Kearns has been appointed manager of a new district sales office at San Francisco for The Bristol Company.

John E. Kearns

Kearns has been with Bristol since 1936. He has served as sales and service engineer at the company's New York, Birmingham and New Orleans offices. For the past four years he has been in the Application Engineering department at the home office, specializing in automatic control.

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Pick the Service You Need	In Our Plant	On Your Site	"In Place"	Pipe Sizes From	To
Cement Mortar Lining of Interiors — Tate Process	..	X	X	4"	16"
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Centrifugal Spinning of Cement Mortar Lining of Interiors	X	..	..	4"	30"
Centrifugal Spinning of Coal Tar Linings of Interiors	X	X	..	36"	144"
Somastic ® Coating	X	X	..	½"	30"
Concrete Coating	X	..	..	4"	30"
Wrapping	X	X	..	4"	30"
Reclamation:					
Removal of Old Wrapping	X	X	..	2"	30"
Straightening	X	X	..	2"	30"
Blasting (Interior or Exterior)	X	X	..	2"	30"
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Roll Welding	X	X	..	2"	30"
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LINE PIPE

up to 30 inch

60-DAY DELIVERY

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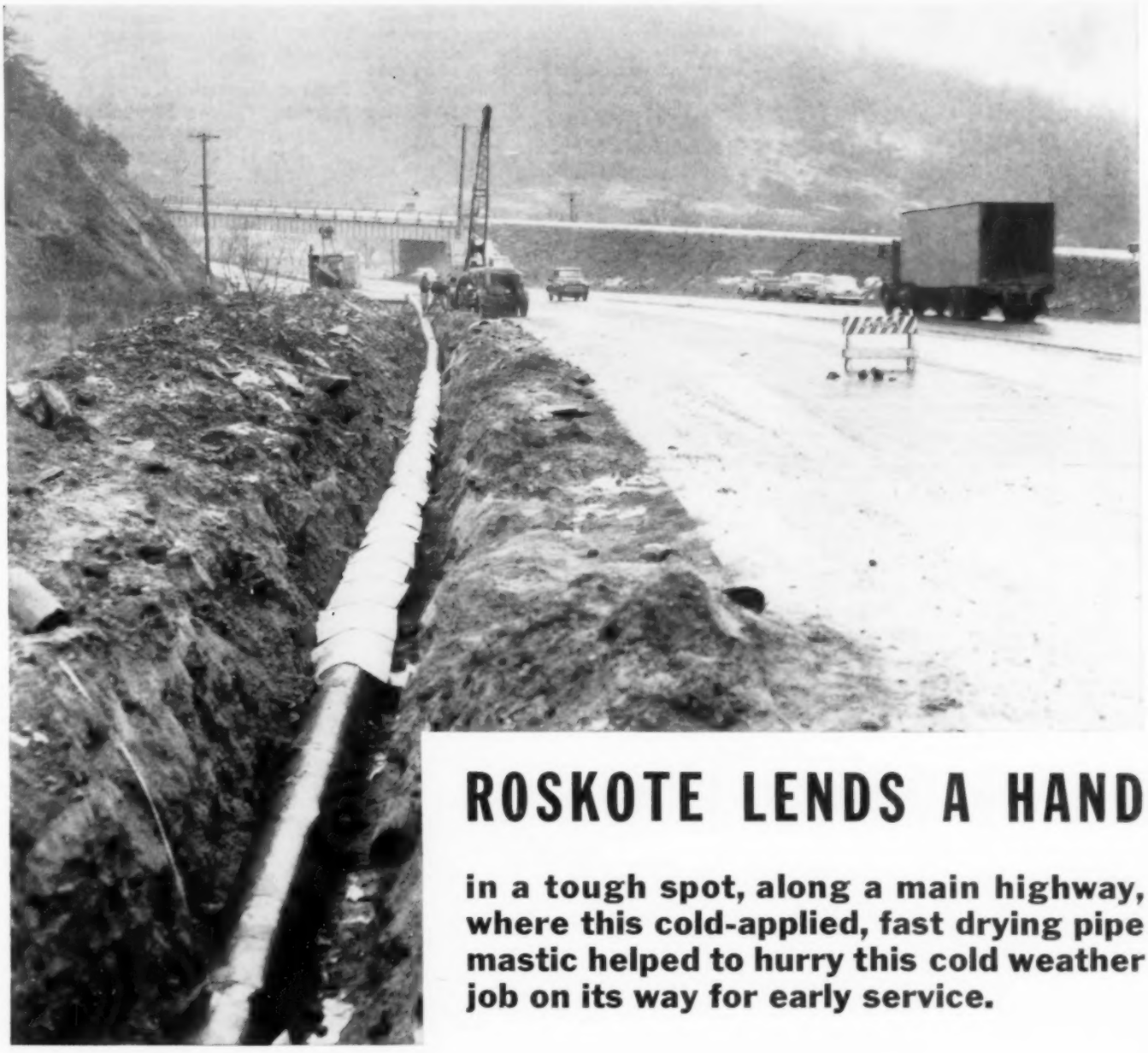

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in a tough spot, along a main highway, where this cold-applied, fast drying pipe mastic helped to hurry this cold weather job on its way for early service.

A large portion of Equitable Gas Company's 18½ mile "Delmont Line" of 16" pipe, was laid 3 feet from the edge of U.S. 22. Cold application of Roskote was ideally suited because of limited working space and it accelerated completion of the line. The pipe was given two coats of Roskote Cold Applied Pipe Mastic and a wrapping of felt. Pipe line padding was used where undesirable backfill was present. For complete information on Roskote, with its high resistance to electrolytic and chemical corrosion, write:

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Distributors Of: Polyken Tape • Dow Magnesium Anodes • Pipeline Felt • Glass Pipe Wrap • Pipeline Padding

For more data on advertised products, use Readers' Service Cards, last page.

for Superior Lubrication

PIPELINERS PICK

LE #1020

HIGH TEMPERATURE LUBRICANT

and L-X

FUEL AND OIL SUPPLEMENT

Because LE lubricants give results — not promises, they are the pipeliner's pick for superior lubrication. LE's fast-growing reputation for top-notch on the job performance is the talk of the pipeline industry.

#1020

HIGH TEMPERATURE LUBRICANT

Built to "take it" on tough pipeline jobs! Scientifically manufactured from carefully selected high quality ingredients and blending oils. LE 1020 "stays put" and protects expensive pipeline equipment. High temperature, pressure and rock-crushing vibration often mean "sudden death" to ordinary greases— but for the lubricant that will outlast and outperform— pick LE 1020.

L-X

FUEL AND OIL SUPPLEMENT

Here's the only fuel and oil supplement engineered for heavy duty engines. Penetrating the pores of the metal, L-X cleans deposits of gum, carbon, varnish and lacquer from valves and rings. Its use means fewer break-downs and repairs— plus more pep and power. Use L-X in your pipeline power units!

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"FULL SPEED AHEAD"
PIPELINERS PICK LE.

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INDUSTRIAL LUBRICANTS
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stitute of Technology, he was first associated with the General Electric Company in the Test and Engineering departments. Later, he was an instructor in electrical engineering at the Bridgeport, Conn., Engineering Institute.

Stewart Joins Schramm As Field and Research Man

Donald E. Stewart has been appointed field and research engineer in the Petroleum Division of Schramm, Inc., with headquarters at Tulsa.

D. E. Stewart

For the past ten years Stewart has done research work and conducted field tests in air drilling for Stanolind Oil and Gas Company in the research center in Tulsa. He studied engineering physics at the University of Tulsa.

Watts to Handle J & L Sales In Gulf Coast District

George D. Watts has been appointed to Jones & Laughlin Supply Division's Louisiana Gulf Coast sales district. He will maintain headquarters at Lafayette, La., and concentrate his sales activities in that area.

Watts joined the supply firm's Brookhaven, Miss., store in 1948. He was transferred to Odessa, Texas, as storeman until his promotion to field sales representative in 1950. Since then he has served as a J & L sales representative in various locations.

Polyken Industrial Tapes Promotes George Stineback

George C. Stineback, general sales manager of Polyken Industrial Tapes, has been promoted to director of sales of the Chicago division of The Kendall Company. Stineback will be responsible for marketing operations of Polyken, Bauer & Black, Bike Web, Blue-Jay, Andrews-Alderfer and Bauer & Black International, which comprise the Chicago division of The Kendall Company.

George Stineback

Before taking over the sales operation of Polyken, Stineback was sales manager of The Kendall Company (Canada) Ltd. Jay Hodges, who has been associated with Polyken for several years, and for the past three years as field sales manager, will take over the responsibility of general sales manager.

Lufkin Trailers Moves Office From Shreveport to Bossier City

Lufkin Trailers, divsion of Lufkin Foundry & Machine Company, has moved its district sales and service offices in Shreveport, La., to new quarters on Highway 80 East in Bossier City, La.

Because of increased sales and product

He's doing it Quickly and Correctly with a

LOWELL #50-A
Reversible Ratchet Wrench

Here's why many major pipe line companies are asking for the new Lowell #50-A Wrench.

1—The reversible ratchet speeds installation of mechanical pipe line couplings.

2—Its special 8" handle assures correct torque on 5/8" bolts.

Other reversible ratchet wrenches available with handles up to 36" lengths.

Be sure of the right wrench for pipe line jobs . . . ask your industrial distributor for the #50-A or other Lowell Series 50 Wrenches.

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Progresssive pipe liners specify E-I-M valve controls

All Over The World

E-I-M VALVE CONTROLS

Are The Guardians Of The Oil And Gas Industry's Life Lines.

E-I-M's air-operated Type A valve control is used in remote areas where other power is unavailable, and it is often used in hazardous areas.

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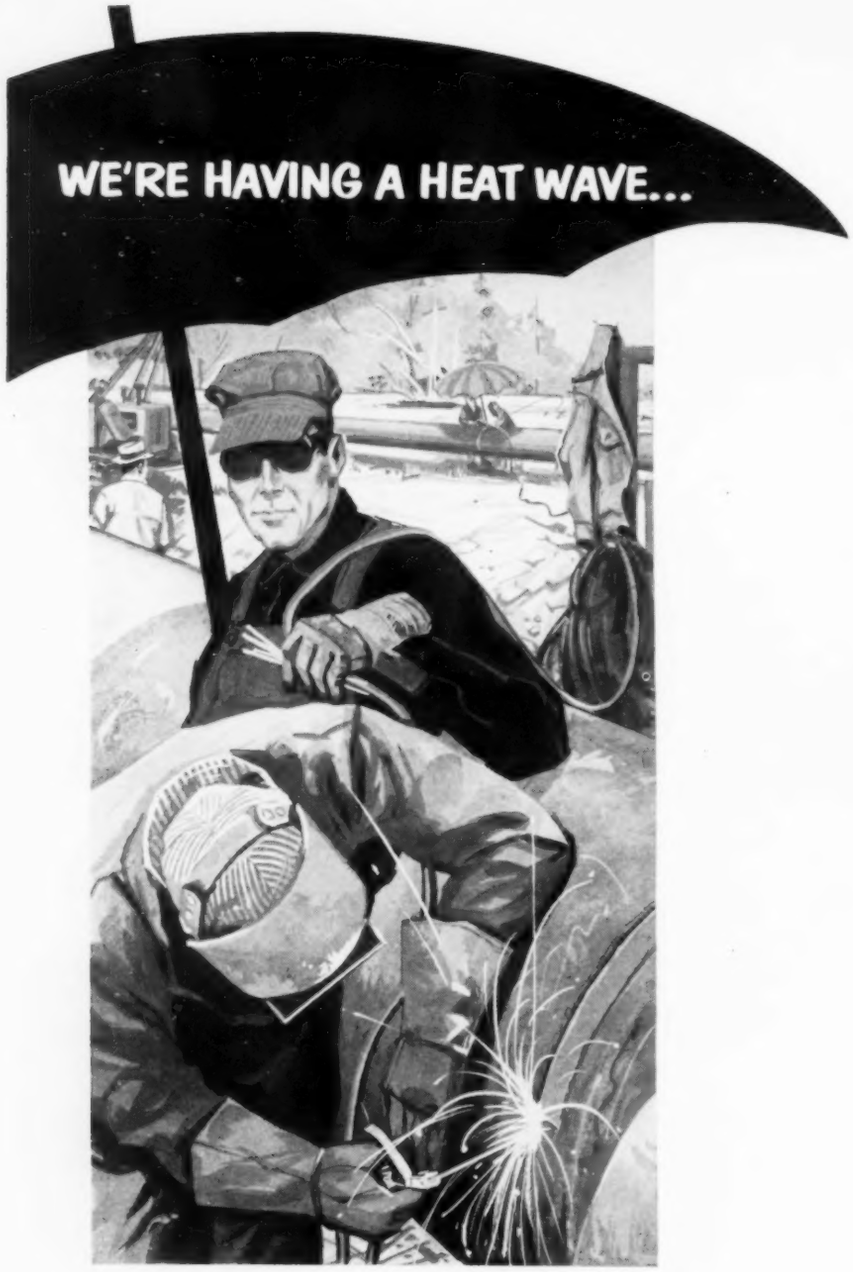
Valve Controls • Speed Reducers • Cooling Tower Drives • Control Valves



... but neither summer sun nor winter snow stops Transco's search for new and profitable markets for natural gas. During 1956, Transco delivered record quantities of gas to heat-hungry markets. This year, look to Transco for a real heat wave ... a wave to increase natural gas movement—to bring heat for warmth and fuel for power to our best potential markets ... the places where the most people are.

HELPING TO EXPAND THE MARKETS
FOR TEXAS-LOUISIANA NATURAL GAS

TRANSCONTINENTAL GAS PIPE LINE CORPORATION

demand in this area, Lufkin Trailers decided to open Shreveport's first factory-owned sales and service branch. Neil Morris, Shreveport branch manager, said four salesmen will have this office as headquarters, serving the Mississippi, Louisiana, southern Arkansas and East Texas area.

Jimmy Walker, who lives in Lafayette, will cover the southern Louisiana territory including New Orleans and Baton Rouge. Ed Morris, residing in Jackson, Miss., will cover that state for Lufkin.

Bob Burns, living in Shreveport, will service the southern Arkansas and part of the East Texas area. Don Butler is inside salesman for Shreveport.

W. C. Hilliard Joins Morris-Young-Owens

W. C. Hilliard has joined Morris-Young-Owens Company, pipe line construction equipment manufacturers, in the equipment sales department. He will represent the company out of the Houston office.

W. C. Hilliard

Hilliard has more than 20 years experience in the field of general and pipe line construction, having worked as welder, foreman, and field superintendent on major pipe line jobs, as well as engaging in general construction work.

Mississippi Road Supply Appointed Distributor for Cleveland Products

The Cleveland Trencher Company has appointed Mississippi Road Supply Company, Jackson, Miss., as distributors for the line of Cleveland trenchers, sidecranes, backfillers and tampers. The distributor's territory includes all of Mississippi except 17 counties.

Officers of Mississippi Road Supply are L. R. Simmons, president; C. H. King, vice president; C. W. Anderson, assistant to the vice president; and Willie O. Stone, sales manager.

How to Get Your 1956 Index

A complete editorial index covering all issues of PIPE LINE INDUSTRY published during 1956 has been compiled and bound separately in convenient pamphlet form. It will be sent free to all subscribers requesting copies.

To get your copy, address orders to the Librarian, Gulf Publishing Company, Post Office Box 2608, Houston 1, Texas. Or if you prefer, you can use the convenient Readers' Service Blue Postcard on the last page of this issue. Just check the square indicated. Fill in your name and address. Drop the postage-paid card in the mail, and the index will be sent you.

Act now. The supply is limited.

Conoflow Corporation Appoints Sales Representative in Mexico

Servo Mex, S.A., Mexico City, has been appointed exclusive sales agency for Conoflow Corporation in Mexico.

Carlos Delgado

Carlos Delgado, principal of the organization, has had a long association with the instrumentation and controls industry. Born in Mexico, Delgado received his advanced education in the U. S. He spent seven years with the Seagrams Distillers Corporation in various supervisory capacities in the Production, Engineering, and Instrument departments. Later Delgado joined Fischer & Porter Company as a sales engineer in the Philadelphia area, and in 1952 returned to Mexico to set up Fischer & Porter De Mexico, S.A. He served as general manager of this company until 1955, when he founded his own sales agency to represent a selected group of control valve and instrument manufacturers.

Mailing address for Servo, Mex, S.A. is Av. Oaxaca 28-206, Mexico 7, D.F., Mexico.

Fisher Governor Representative For New England Area Named

Fisher Governor Company's new sales representative for Boston and the New England area is Clarence B. Petty & Company, 50 Kearney Road, Needham Heights 94, Mass.

Other sales engineers who will assist Clarence Petty are Walter Taylor and Steve Lord.

Rojtman Elected to Post With J. I. Case Company

Final consolidation of American Tractor Corporation into J. I. Case Company has been completed and Marc B. Rojtman, former president of American Tractor, was named to the new position of executive vice president and general manager of J. I. Case. Rojtman will have authority over overall operation of the newly-merged company.

Marc B. Rojtman

Rojtman has also been elected to the board of directors and will serve on the executive committee. Two other members of the former American Tractor board, Mentor Kraus of Ft. Wayne, Ind., and Edward Elliott of New York, also have been elected to the Case board of directors.

Market Development Head Appointed by General Electric

Kent J. Worthen, formerly district sales manager for General Electric mobile communications equipment at Los Angeles, has been appointed market development manager for the General Electric Communication Products department and will coordinate the company's activities in the sale of two-way radio to new user markets.

Worthen, who will be located at the General Electric Communication Products department headquarters in Syracuse, N. Y., has a decade of experience in the radio engineering field. He was an engineer for Radio and TV Stations KSL and KSL-TV before joining the General Electric Company as a test engineer in 1949.

In 1950, he was assigned to the field engineering staff of the company's Technical Products department and in 1951 was appointed district sales manager for communication equipment in Los Angeles.

New Sales Department Formed At Worthington Corporation

A new Industrial Centrifugal Compressor Sales department has been established by the Harrison division of Worthington Corporation. This new Sales department will bring under the Harrison division all handling of industrial centrifugal compressors including engineering, manufacturing and sales.

E. C. Schmachtenberg

C. K. Hood, vice president and manager of sales for the Harrison division, has appointed Everett C. Schmachtenberg, formerly assistant to the manager of engineering at Harrison, to head the department.

Schmachtenberg has been with Worthington for more than 19 years.

Buechler Joins Tube Turns' Sales Development Staff

Clarence Matthews Buechler has joined the Sales Development department of Tube Turns.

Buechler, born in Louisville, obtained his A.B. degree in chemistry at Bellermine College and his M.B.A. degree in business and marketing at the University of Chicago.

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Career Opportunities for Graduate Engineers experienced in estimating—economic analysis or design of oil and gas pipe lines. Openings in the United States and abroad.

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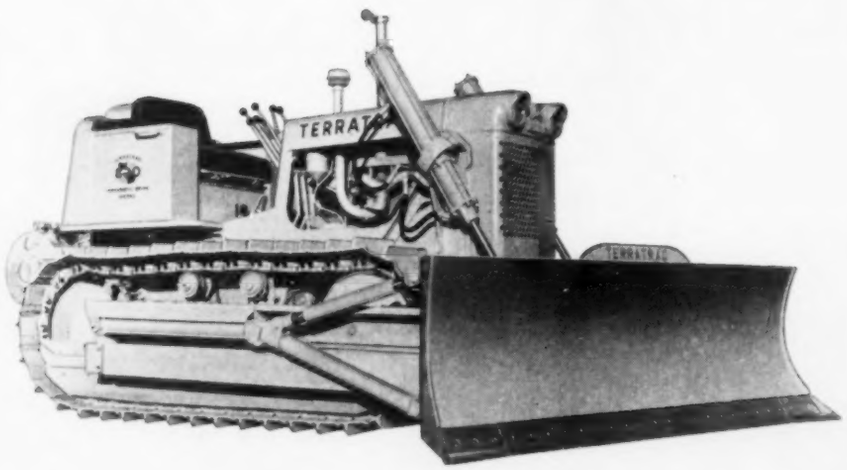
What's New in Equipment

for the Pipe Line Industry



Industrial Wheel Tractors

J. I. Case Company has introduced a new line of industrial wheel tractors, Terra-Trac crawlers and earth-moving equipment. Included in the new Case Terra-Trac industrial line are three separate equipment packages covering:

1. Industrial utility wheel tractors with matching equipment to be distributed by farm dealers.
2. Larger light construction wheel and crawler units for distribution through industrial dealers, specializing in residential and commercial building.
3. Heavy construction and road-building equipment to be handled by large AED-type industrial distributors.

The present Case TerraTrac industrial line covers 20 gasoline and diesel-powered tractors, ranging from 40 to 80 horsepower in rubber-tired equipment and up to 100 horsepower in crawler models.

The new Case industrial rubber-tired tractors and matching equipment are engineered for industrial service and include such features as drop-forged front axle, power steering, shuttle transmission and foam rubber industrial seat for operator comfort. These wheel units include heavy duty bumpers and radiator guards, streamlined recessed headlights and a heavy duty sub-frame assembly for mounted equipment. The Case backhoe for these units has an exclusive foot-pedal-actuated, 180-degree swing, telescopic tubular outrigger extensions and close-coupled mounting which provides perfect operating balance. The wheel loaders feature 25-degree roll-back and hydraulic leveling.

For more data, circle **No. E1** on Readers' Service Card, last page this issue.

Corrosion Measuring

Crest Instrument Company has developed instruments and techniques to measure the rate of progress of corrosion on an exposed element of a probe by measuring the changes in electrical resistance as the cross section is reduced.

The Corrosometer method measures corrosion by installing a special probe in the system under study, then follows the progress of corrosion on the probe electrically by means of a special meter. The Corrosometer probe consists of an exposed element which is part of an electrical circuit used to make resistance measurements on the element. The exposed element is made of whatever metal is of interest and can be used in three different forms—round wire, flat strip or thin wall tubing. The Corrosometer instrument determines the extent of corrosion on the exposed element of a probe by measuring the changes in electrical resistance as the cross section is reduced and gives readings in terms of micro-inches of corrosion.

Among the features are that rapid and direct measurements require only 30 seconds and readings on probes may be taken as often as desired on the same probe with no shutdown required to retrieve metal specimen. Cables are extended from the probe to measure inaccessible places.

The Corrosometer instrument is available in three models, a portable unit for use in field or laboratory; a unit designed for use in the laboratory and in plants where a.c. power is available, and an automatic recording instrument suitable for laboratory and industrial applications.

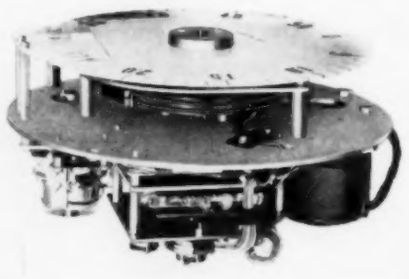
For more data, circle **No. E3** on Readers' Service Card, last page this issue.

Potentiometer

The Bristol Company has made available a new self-balancing electronic potentiometer servo-mechanism, furnished without a case and designed to be built into a user's equipment.

The mechanism consists of a group of standard Dynamaster instrument parts assembled on a circular base and fitted with an indicating scale. When used with a Bristol amplifier, input transformer, and Synchroverter d.c. a.c. inverter, it forms a complete self-balancing dial indicator. The unit is available as a potentiometer or as an a-c bridge. Dial indicator speeds of 1 second, 3 seconds and 4½ seconds are offered and one blind set alarm switch can be furnished. The unit can also be supplied with a retransmitting slidewire.

Applications for the new servo-mechanism include use as a low cost indicating pyrometer, resistance thermometer, or potentiometer to be incorporated into user's



equipment: as a replacement for a direct deflecting d.c. milliammeter of millivoltmeter, where better accuracy or reliability is required, or for use as a self-balancing unit to operate analog-to-digital conversion mechanisms for readout.

For more data, circle **No. E2** on Readers' Service Card, last page this issue.

J & L recognizes a difference in PLUG VALVES

J&L recognizes — intelligently — a difference in all valves.

There is, definitely, a difference in the quality of *plug* valves.

You expect top performance from special lubricated plug valves recommended by J&L Supply for engineered installations.

But you also get top performance from plug valves stocked by your J&L store for less exacting requirements.

Custom-fitting the valves for *your* job is only one example of J&L Supply service. Desirable differences in Walworth Plug Valves add up to important economies for J&L customers.

Jones & Laughlin

SUPPLY DIVISION – Tulsa

SERVING THE UNITED STATES AND CANADA

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For more data on advertised products, use Readers' Service Cards, last page.

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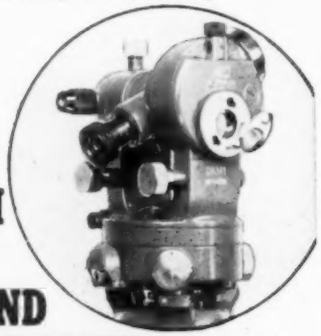

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- Can be used with electric lighting unit for night work.

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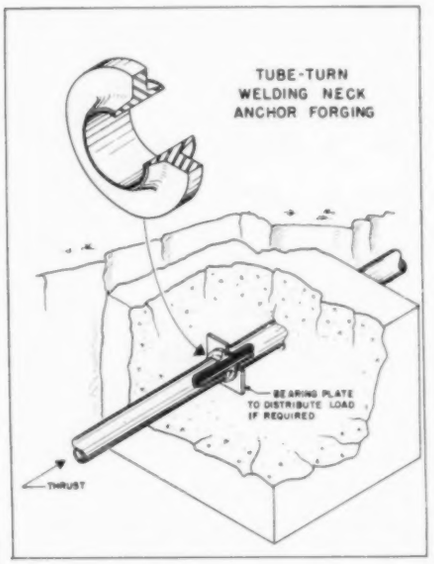
Side Boom

Pneumatic Pipelayers Inc. has introduced a side boom, known as the "Sooner Boomer," which is mounted on rubber tires and is designed to handle pipe up to 10 inches. The "Sooner Boomer" eliminates unnecessary right-of-way damage on city work. It operates at road speeds on backhaul, and is equipped with a swamper platform. Power up and power down on all cables assures safety and precision lineup. The "Sooner Boomer" easily lowers in or bends 8-10 inch pipe. It is designed to put all weight on wheels, eliminating any strain on engine, transmission and differential.

For more data, circle **No. E4** on Readers' Service Card, last page this issue.



Anchor Forging

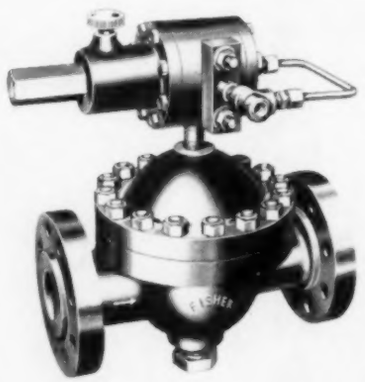
Tube Turns has introduced an improved welding neck anchor which is said to solve the problem of satisfactorily anchoring high pressure oil and gas pipe lines at compressor stations, river crossings and valve and meter settings.

The forging takes the form of a double hubbed flange with no bolt holes which may employ a bearing plate to distribute the load. The hubs, of the straight taper type recently adopted by MSS for large diameter pipe line flanges, are butt welded to the pipe where it is to be held immobile, and the assembly is buried in a reinforced concrete block of suitable dimensions.

The Tube-Turn welding neck anchor forging is produced in any of the materials customarily used for flanges. It is available in sizes to match any pipe dimensions and for the usual pressure conditions.

Properly used, the forging helps protect valves and other compressor station equipment from possible damage and reduces maintenance costs and hazards that may occur when conventional steel straps are used for anchoring purposes.

For more data, circle **No. E5** on Readers' Service Card, last page this issue.



Relief Valve

A new relief valve has been announced by Fisher Governor Company in which the main valve has only one moving part, the rubber diaphragm, which flexes to open or close the valve. Known as the "Dia-Grid," this pilot operated relief valve provides positive shut-off operation, is rugged, compact and easy to maintain. It is available in 2-inch, 4-inch, 6-inch and 8-inch connections with flange ratings of 150, 300 and 600 pounds.

One pilot is available for use with Dia-Grid for safety relief service at compressor, town border and district regulator stations. It can be adjusted for relief ranges from 10 to 600 psi.

(This item supplements Fisher Governor Company data on pages 1706-1707 of the Composite Catalog, 21st Edition.)

For more data, circle **No. E6** on Readers' Service Card, last page this issue.

T10 – a new and heavier ALLEN MOBILE CRANE

Built to the same high standard as its smaller contemporary —the well-known model K—this new mobile crane/ excavator will give the same long, trouble-free service, with a much bigger performance.

Designed and built at Cowley, the six-wheeled chassis is powered by a Gardner 5 L.W. oil engine, giving 94 b.h.p. at 1,700 r.p.m.

There is a separate power unit (Gardner 4 L.W.) for turntable

Using the standard lattice boom the T.10 can be equipped for grab, dragline or crane work.

Please write for full particulars.

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The Alston Pipe Cutter completely eliminates sparks . . . no line explosions. No more time consuming pipe bleeding.

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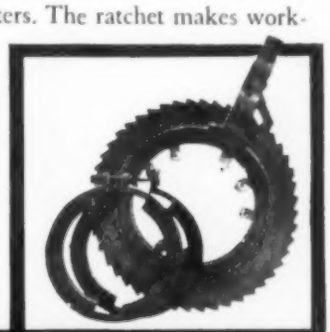
This tool cuts 10-inch pipe in less than 15 minutes. Roller guides eliminate broken cutters. The ratchet makes working in close places easy.



saves money

Begin to use this precision made cutter in your pipeline operation for safer, quicker, economical pipe cutting. Write for literature and prices.

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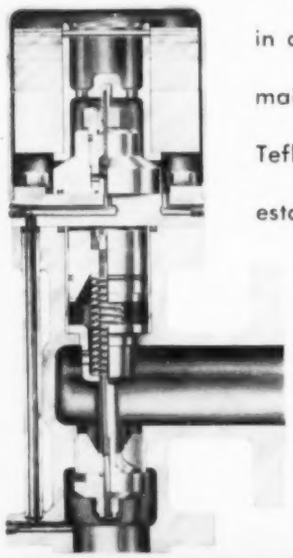
ANNOUNCING

THE NEW
MODEL 412 KINZBACH PRESSURE RELIEF VALVE

The new, improved Kinzbach Model 412 relief valve for pipelines and refineries, has a ball seated pilot valve, usually dead weight loaded, but optionally spring loaded.

Eleven advantages are included in the design and operation of this new model:

1. Positive action — line pressure is utilized for opening and closing.
2. Dependable. Opening pressure is pre-set by application of dead weight or spring load.
3. Instantaneous opening to full capacity.
4. Automatic reseating.
5. No chatter or wire-drawing at seat.
6. Functional Testing. Hand lifting of pilot stem operates valve at **any** pressure.
7. Simple and rugged. Valve contains only two moving assemblies.



8. High capacity. Ample flow area provided in all sizes.
9. Positive Seating. Line pressure utilized to maintain valve shut.
10. Corrosion resistant. Full stainless trim with Teflon disk.
11. No pressure accumulation needed. Full lift established immediately.

Model 412 Valve sizes are 2", 3", 4", 6" and 8" with working pressures up to 1000 p.s.i.; pilots are available in four ratios: 5:1, 10:1, 25:1, and 50:1. For complete details on this and other Kinzbach pressure relief valves, write for new catalog.

KINZBACH TOOL CO INC

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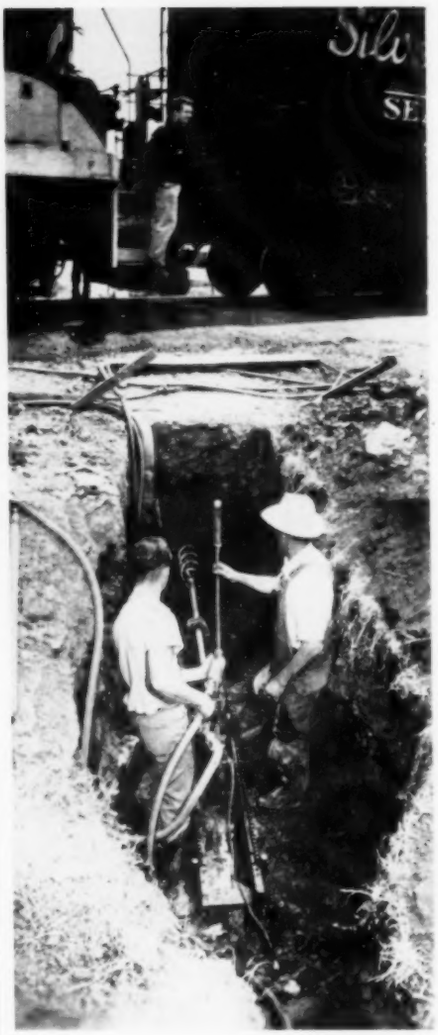

Earth Boring Machines

Boring speeds of the latest Hydrauger horizontal earth boring machines made by Hydrauger Corporation have been increased as much as 40 percent as the result of redesigning and incorporation of the latest high torque (high power) Ingersoll-Rand multi-vane air motors. This is a special motor built to bore and cut through the toughest tree roots encountered while boring underground for pipe and conduit installation and for soil drainage.

The Hydrauger principle of operation is classed as wet hole boring. Water, forced through the hollow steel boring bar sections cools the cutting bit, washes cuttings from the hole and muds the hole walls. Cool bits allow the Hydrauger operator to gain full advantage of the new high-torque (high power) air motors; he can crowd the bit into the formation as the lugging power of these motors maintains speed and full power right up to their stalling points.

The straight, open hole produced by the Hydrauger allows installation of many kinds of pipe; even the new asbestos-cement types with O-ring couplings are easily snubbed into place.

For more data, circle **No. E7** on Readers' Service Card, last page this issue.

4-CYCLE

KVS compressors are chosen for Palmyra Station of Northern Natural Gas Co.

When the Northern Natural Gas Company recently expanded its transmission station at Palmyra, Nebraska, two 2000-hp Ingersoll-Rand turbocharged KVS gas-engine compressors were put on the line to handle the capacity increase. An additional 2000-hp KVS unit is scheduled for installation at Palmyra this year.

These new 4-cycle units offer substantial fuel savings over older-type engines, floor space requirements are much smaller, and the operators appreciate the quiet operation.

Other significant features that go with the KVS include the flexibility and smooth operation characteristic of a 4-cycle unit, and the efficiency and dependability of I-R compressor cylinders with Channel Valves*.

Northern Natural was familiar with Ingersoll-Rand equipment, because there are over 75,000 hp of I-R gas-engine units at other stations of Northern and its subsidiaries. Other I-R products at Palmyra include the 4-cycle gas-engine generating units, the starting-air compressors and the cooling-water pumps.

Ingersoll-Rand equipment offers many important advantages for pipeline service. Ask your I-R representative for the complete story.

*Only I-R compressors have CHANNEL VALVES

Known for high efficiency, quiet operation and exceptional durability. Entirely different. Each valve is a combination of rigid stainless-steel channels and leaf springs, with trapped-air spaces which cushion action.

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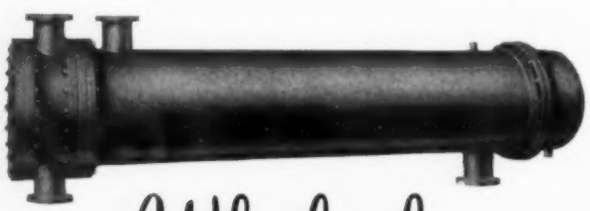
The efficient operation of your compressors — in fact, their *life* — depends on the removal of waste heat from lubricating oil and water cooling systems. The Whitlock Type SG Cooler is specially designed for such service. It is small yet capable of handling relatively high heat loads, and its standardized design means low cost and prompt shipment.

The cooler is two-pass in design and properly baffled to develop high fluid velocities and subsequent high heat transfer rates, with minimum pressure drop. Its non-ferrous tube bundle, cast iron channel and steel pipe shell mean long, trouble-free equipment life even under severe operating conditions. Bulletin 122 gives you the whole story on Whitlock Lube Oil and Jacket Water Coolers. For your copy, just fill in and return the coupon today.



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WHITLOCK Designs and builds: bends, coils, condensers, coolers, heat exchangers, heaters, piping, pressure vessels, receivers, reboilers.

THE WHITLOCK MANUFACTURING CO.
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☐ Please send Bulletin 122 describing Whitlock Lube Oil and Jacket Water Cooler — Type SG.

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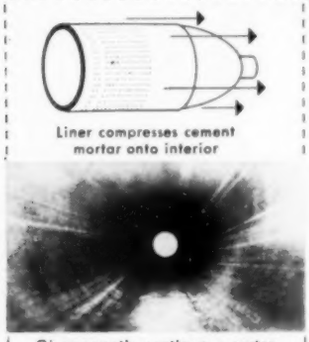

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Gives smooth, continuous, water proof lining of correct thickness

Tate Process applies cement mortar lining to the interior of 4" to 16" lines quickly and economically . . . while the lines stay "in place." Permanently restores full flow coefficients. Reduces pumping and maintenance costs. Protects against corrosion, contamination.

Write for full information TODAY!

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At W. H. Curtin & Company you will find complete stocks of the finest quality equipment for gauging petroleum — available for immediate delivery. Here are four popular items:

① **Curtin Centrifuges, API, 15 cc and 100 cc.**
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③ **Curtin Wood Case Tank Thermometers, API-ASTM.**
④ **International Centrifuges, API, 15 cc and 100 cc; for operation on 6-volt or 12-volt storage batteries.**

Our technical staff will be glad to assist you in selecting the right equipment for your operation. Write for our "List of Gauging Equipment for Petroleum."

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New Equipment Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader Service postcards just inside the back cover and facing the Advertisers Index. Simply circle code numbers of items desired—sign and mail card.

Corrosion Control

An illustrated booklet describing the advantages of Transtex Poly Vinyl tape for covering and protecting pipes, valves, frames, racks and metal surfaces against corrosion above and below ground has been published by the Dutch Brand division of Johns-Manville. The booklet contains illustrations, technical data, characteristics and performance specifications.

To get a copy, circle **No. E8** on Readers' Service Card, last page this issue.

Metering Pump

A low capacity, medium pressure unit which accurately proportions various solutions or chemicals is described in a new bulletin by Proportioneers, Inc. Features of this pump, known as the Proportioneer Model 1105, are listed with descriptive data, capacity table, cutaway dimension drawings. The Model 1105 is available in six types covering a capacity range from 0.12 to 20 gph. Volumetric accuracy is guaranteed from maximum to one-fifteenth of maximum displacement within plus or minus 1.0 percent.

To get a copy, circle **No. E9** on Readers' Service Card, last page this issue.

Steel Tube Fittings

The Weatherhead Company, Fort Wayne Division, has made available a new catalog of engineering data on Weatherhead 7000 Series and 8000 Series Ermeto hydraulic flareless tube fittings and Weatherhead "Flare-Twin" S.A.E. 37 degree flare (J.I.C.) hydraulic tube fittings. A section is devoted to assembly instructions, materials, finishes and operating pressures.

To get a copy, circle **No. E10** on Readers' Service Card, last page this issue.

Plug Valve

The 40th anniversary of the invention of the lubricated plug valve has been commemorated in a 20-page edition of "The Flow Line," a Rockwell Manufacturing Company publication. The magazine describes the invention of the lubricated plug valve by Sven Nordstrom and early experiences of Nordstrom valve salesmen attempting to introduce the new invention to skeptical industrial engineers of the time.

To get a copy, circle **No. E11** on Readers' Service Card, last page this issue.

Compressor Line

A new bulletin showing a complete line of small air-cooled compressors for industrial, automotive, commercial and general use is offered by Gardner-Denver Company. The compressors described are used for many shop jobs. Both one and two stage compressors are offered with working pressures ranging from 85 to 175 pounds per square inch. Models shown include bare compressors and those with horizontal and vertical tanks. Two handy charts, one for figuring compressor needs and another showing estimated free air consumption for 30 common shop jobs, are printed.

To get a copy, circle **No. E12** on Readers' Service Card, last page this issue.

Blocks and Sheaves

Durolite blocks are now available for any job or machine where a top quality block is required. These blocks are used on Sauerman Drag Scraper Machines and Cableways for easier handling and to reduce wear on the running ropes. Durolite sheaves are lighter in weight than other sheaves of the same rated capacity but provide high structural strength and durability for handling heavy loads at high speeds. Other features and specifications are described in the new bulletin issued by Sauerman Bros., Inc.

To get a copy, circle **No. E13** on Readers' Service Card, last page this issue.

Move Coupler

John Bean Division, Food Machinery & Chemical Corporation, has issued a bulletin on its fast move coupler, which allows saving of labor, weight and time. Only one-sixth the man-hours are required to string and pick up a portable aluminum pipe line with fmc fast move couplers as for comparable capacity steel pipe with ordinary couplers. The bulletin points out some of the applications for aluminum pipe plus fmc couplers such as for supply or disposal lines to handle water, steam, natural gas, butane, oil and other similar commodities. It is especially useful where portability is required as when lines must be moved frequently.

To get a copy, circle **No. E14** on Readers' Service Card, last page this issue.

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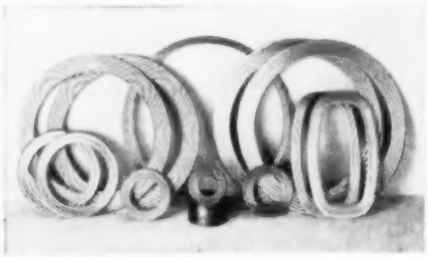

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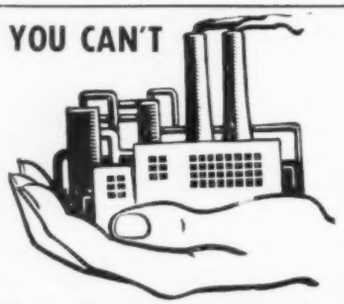

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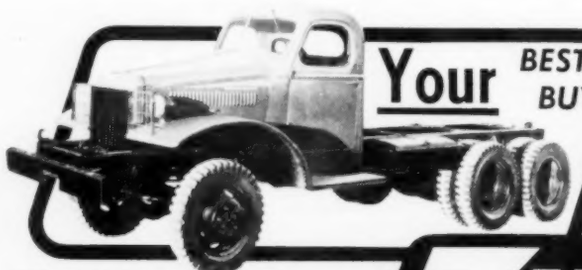

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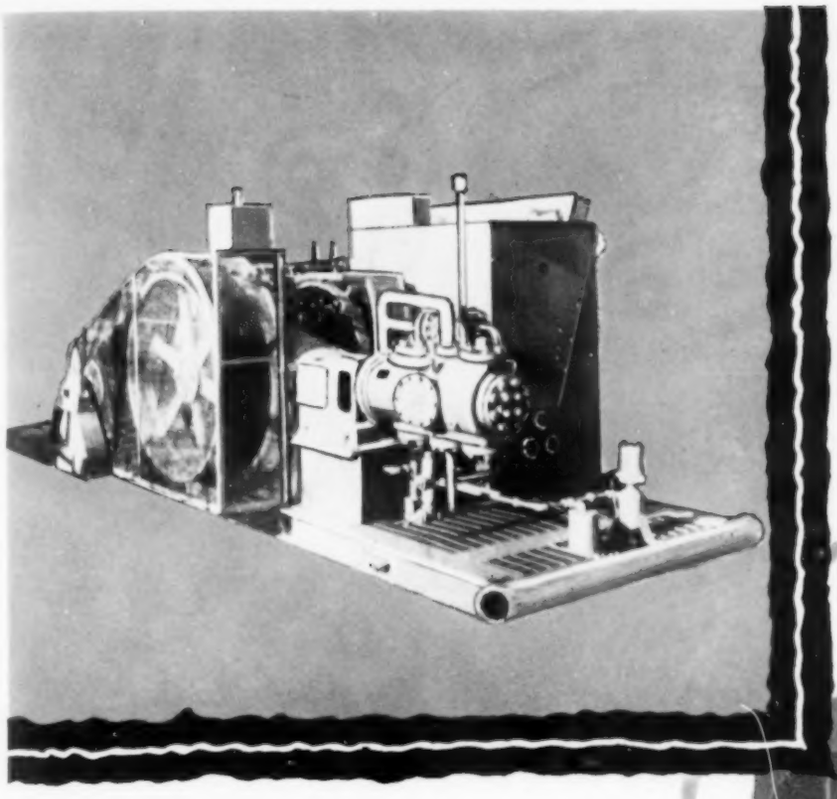

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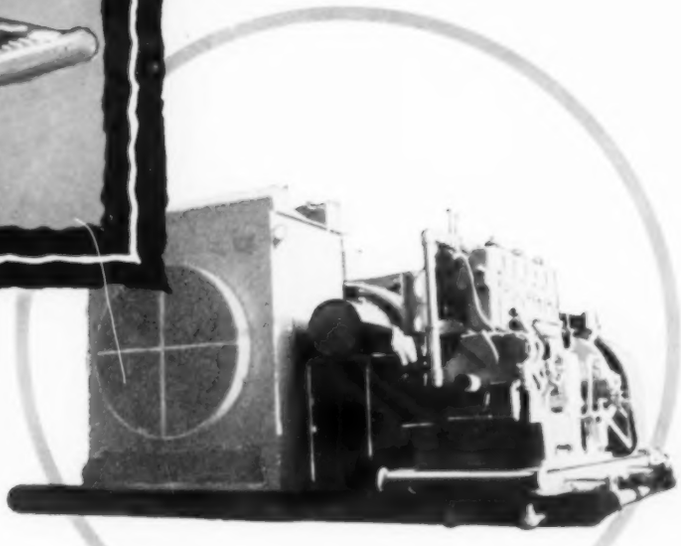

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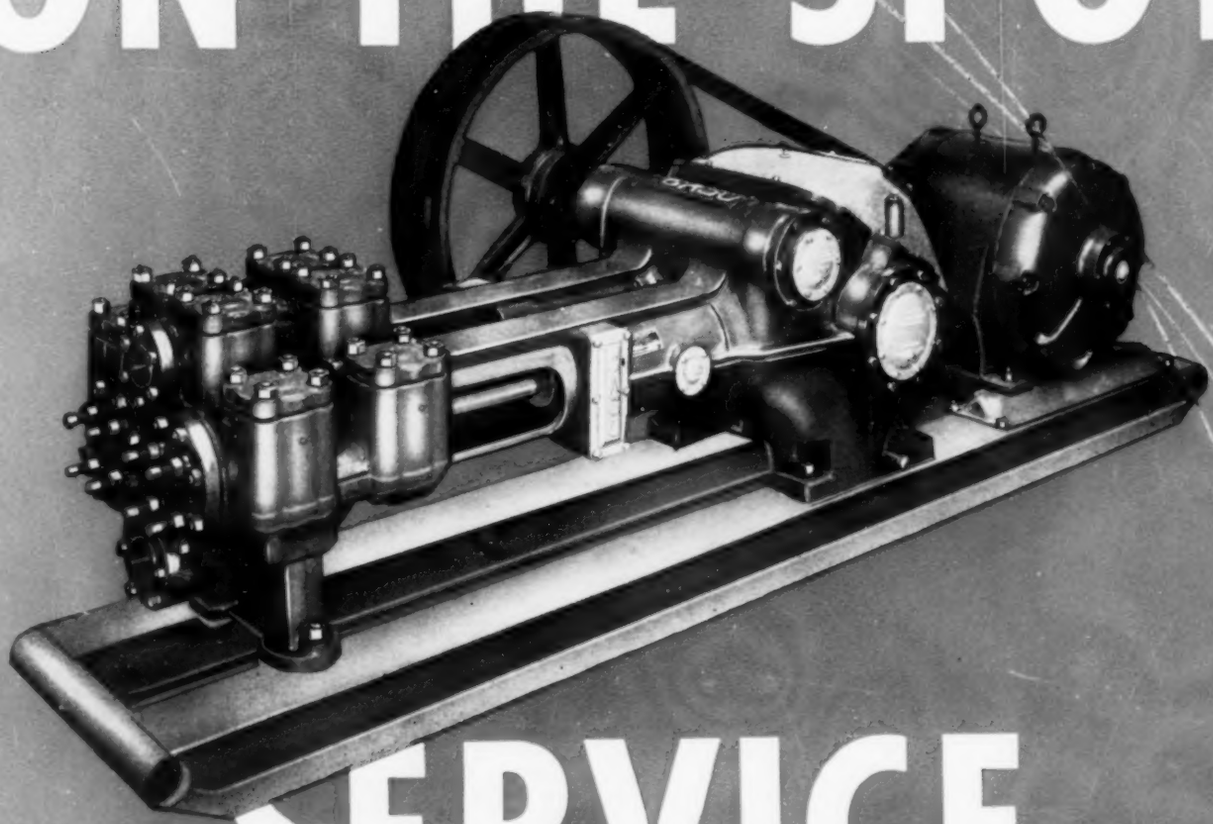

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